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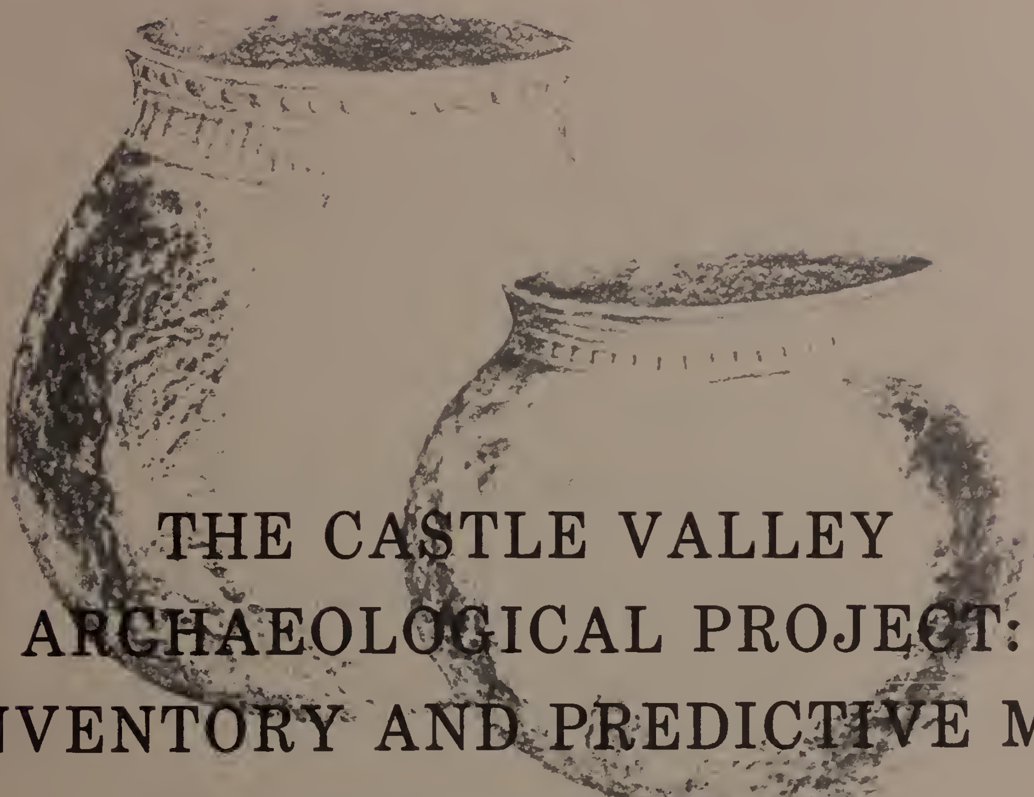

THE CASTLE VALLEY ARCHAEOLOGICAL PROJECT: AN INVENTORY AND PREDICTIVE MODEL OF SELECTED TRACTS

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Anticipated coal development and BLM realty actions precipitated the need for the archaeological data presented in this study. These data will be used for area planning and environmental analyses. Three adjoining areas located in Castle Valley, Moab District, were chosen for inventory and are the basis for developing a predictive model for site location. The Elmo tract consisted of 14,000 acres involving a 20% sample; the Emery tract of 37,000 acres, a 10% sample; and 25 dispersed parcels of land, totaling 2,400 acres, a 100% survey; the total being an inventory of 8,880 acres. Data from 143 sites in these tracts were combined with existing information to develop a predictive model for the Elmo and Emery tracts using discriminant analysis and logistic regression statistical methods.

Although an 82% overall classification rate was achieved for the Emery tract, data for Elmo were insufficient to generate a statistically defensible model. The field work was completed by Metcalf Archaeological Consultants, Inc., Eagle, Colorado in 1983 and 1984; the report was submitted to BLM in June 1985. Hopefully, these data will generate interest and provide guidance for future work in the area. Utah BLM, a pioneer in development and implementation of predictive models, is pleased to present this volume.

Richard E. Fike
Bruce D. Louthan
Editors

Abstract

An archaeological inventory totalling 8,880 acres in three study tracts has been completed in the Castle Valley locality of central Utah. The Elmo Tract is a 14,000 acre area in the northern valley where a 20% sample of eighty acre survey units resulted in the discovery of eight sites (two historic, six prehistoric) and 36 isolated finds. The Emery Tract in the southern valley is a 37,000 acre block in which a 10% sample survey within similar 80 acre units led to the identification of 109 sites--nine of which had been previously recorded and ten containing Historic period components--and 77 IFs. Between these two sampled tracts lie the Scattered Small Tracts, consisting of 25 land parcels ranging in size from 40 to 320 acres, where 26 sites (including two Historic period components and one paleontological locus) and 30 IFs were recorded. Thus, a total of 143 sites and 143 IFs has been identified within 106 separate land units in the three study tracts. Cultural affiliations are with the Paleo-Indian, Archaic, Fremont, Ute and Euro-American groups; 65 of the 143 sites are evaluated eligible or potentially eligible for the National Register of Historic Places. Using map-readable environmental variables, predictive models of site location have been developed through the discriminant analysis and logistic regression statistical methods. Testing of preliminary versions of one of these models resulted in refinements such that an 82% correct classification rate for sites was achieved. The contributions of the data base to local culture history, and problems and prospects for future predictive modelling efforts are discussed.

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Acknowledgements

The successful completion of this project would not have been possible without the cooperation and advice of contracting officer Shirley M. Combs and, particularly, Blaine Miller of the BLM in Price (contracting officer's authorized representative). Appreciation is also expressed to the Utah Parks and Recreation Division personnel at Huntington State Park, for allowing us extended use of their facilities at an affordable cost during survey of the Elmo Tract. Thanks go to graduate students James Kirkland and Jeff Eaton at the University of Colorado for marine fossil identifications, to T. C. Peebles for his help at the computing center, and to the University of Denver for use of their computing facilities. The generosity of many local landowners in granting us access across their property is very much appreciated. Finally, the patience and perseverence of our many crew members is acknowledged. Thanks to all.

CHAPTER 1

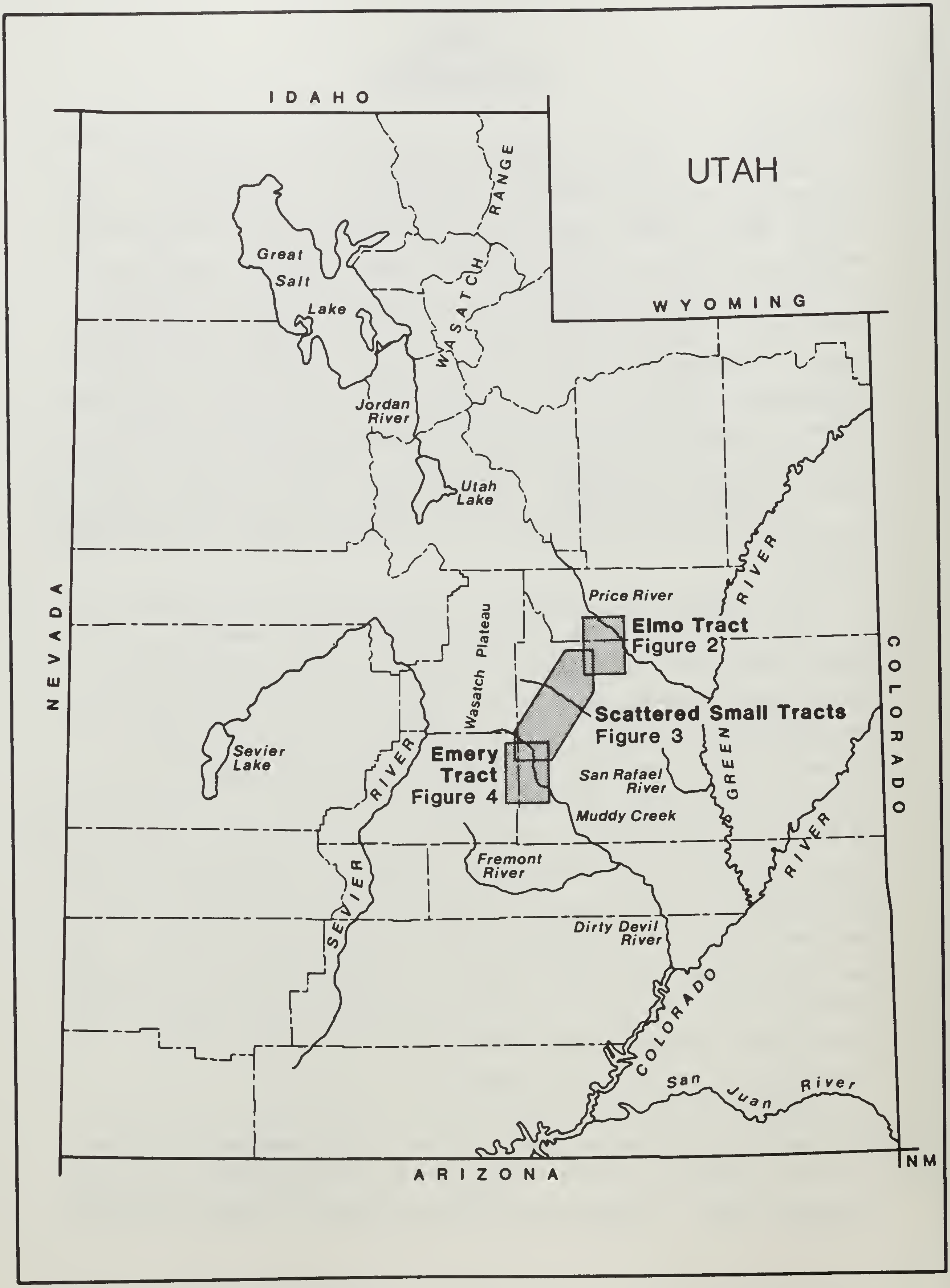
Introduction

The Survey

In September, 1983 the Bureau of Land Management (BLM) awarded contract No. YA-551-CT3-440049 to Metcalf-Zier Archaeologists, Inc. (the company name was later changed to Metcalf Archaeological Consultants, Inc, hereafter referred to as MAC) of Eagle, Colorado for the purpose of conducting a Class II cultural resources inventory within the Castle Valley area of central Utah (Figure 1). The BLM required a predictive model of prehistoric site locations to be developed using this survey information in order "to provide data for area planning and environmental analysis in anticipation of coal-related development and BLM realty actions" as well as "to gather detailed cultural resource data in order to define the nature and diversity of the resource including significance and to identify future research needs and directions" (Dept. of Interior-BLM 1983:24).

Three separate study tracts were to be inventoried at various levels of intensity. Prior to "BLM realty actions", a 100% inventory of 2,400 acres within 25 separate parcels was conducted between Elmo and Emery, Utah in the "Scattered Small Tracts" (SST). This preliminary work by MAC was conducted between October 24 and November 4, 1983. During the following field season, more substantial surveys were completed in the other two study areas. The Elmo Tract, a 14,000 acre block near the town of Elmo, was inventoried at a level of 20% (i.e. 2,800 acres) between July 18 and July 25, 1984. From August 1 to October 13, 1984 the Emery Tract was surveyed at the 10% level of intensity--3,680 of 37,000 acres were surveyed in this tract spread east and south of the town of Emery. Both the Elmo and Emery Tracts were sampled via randomly chosen 80 acre units. Thirty-five such units were inventoried in the Elmo Tract while 46 units were surveyed within the Emery Tract; 8,880 total acres have been inventoried in the three study tracts.

The three study tracts identified above cover nearly the entire 65 mile length (ca. 105 km) of Castle Valley. Legal descriptions of these areas are presented in Table 1 along with the pertinent USGS topographic quadrangle maps. All 8,880 acres surveyed by MAC are lands administered



PROJECT AREA LOCATION **FIGURE 1**

TABLE 1

Location of the Three Study Tracts

Parcel	Legal Description	USGS Quad Maps	
Elmo Tract	T15-17S, R10-11E, Carbon & Emery Counties	Elmo	7.5' (1969)
		Cow Flats	7.5' (1969)
		Cleveland	7.5' (1969)
		Olsen Reservoir	7.5' (1969)
Emery Tract	T22-24S, R5-7E, Emery & Sevier Counties	Mussentuchit Flat	7.5' (1968)
		Mesa Butte	7.5' (1968)
		Emery East	7.5' (1968)
		Willow Springs	7.5' (1968)
		Walker Flat	7.5' (1968)
Scattered Small Tracts	T16-22S, R6-10E, Emery County	Elmo	7.5' (1969)
		Huntington	7.5' (1969)
		Hadden Holes	7.5' (1969)
		Ferron	7.5' (1979)
		Emery East	7.5' (1968)
		Emery West	7.5' (1968)
		Castle Dale	15' (1923)

by the BLM. The Elmo Tract and the three northernmost parcels of the Scattered Small Tracts are within the Price River Resource Area of the Moab District; the remainder of the SSTs and that portion of the Emery Tract within Emery County are within the San Rafael Resource Area of the Moab District. The Sevier County portion of the Emery Tract is within the Sevier River Resource Area of the Richfield District.

Michael D. Metcalf was principal investigator for the project, and Blaine Miller (BLM Area Archaeologist in Price, Utah) was the Contracting Officer's Authorized Representative (COAR). Kevin D. Black, staff archaeologist at MAC, was the field director and crew chief for one survey team. Anne McKibbin served as crew chief for a second survey crew, and also drafted the maps and line drawings for this report. Crew chiefs for shorter portions of the inventory included Michael Metcalf, Stephen Kalasz and Robert Nykamp. Crew members for various periods of time on the project were Andrea Barnes, Christopher Coder, Richard Cornelius, Brenda Martin, Karen McKibbin, Julie Medsker, Ian Mehl, James Miller, Sylvia Miller, Suzanna Montague, Robert Nykamp and Lauri Travis. All work was conducted under the provisions of BLM Antiquities Permit #83-UT-049.

Development of the Predictive Model

The Class II survey and predictive model reported herein is the most recent of a number of large-scale surveys conducted in the Castle Valley area during the past decade. This previous work runs the gamut from "Class I" literature searches and summaries to intensive "Class III" inventories of linear and block areas within the region. Thus, the present project builds upon an impressive data base--a relatively rare circumstance in many areas of Utah and adjacent regions--and should set the stage for much more selective, problem-oriented archaeological research in the immediate future. Class I summaries exist for Castle Valley and Emery County as a whole (Sargent 1977; Hauck 1979a), and for the entire Castle Valley relating specifically to site location preferences (Holmer 1982). Intensive inventory of various portions of the Castle Valley is represented in reports by Gunnerson (1957a, 1969), Helm (1973, 1974; also see Berry 1974), Berge (1973, 1974), Louthan and Berge (1975), Hauck (1976), Berge and Nielson (1978), and Brown (1985). See Holmer's (1982:55-69) bibliography for references on the numerous small-scale clearance surveys conducted in this area.

More comparable to the present project are the following reports on Class II sample surveys. Hauck (1979a) describes the results from a huge Class II inventory of the Central Coal Project which, although only involving a 1% sampling fraction, includes interpretations of settlement patterns in the entire Castle Valley area as well as in adjoining locales. A follow-up survey to Hauck's work, the Central Coal II Project, is reported by Weed and Altschul (1980) and Thomas et al. (1981), and describes the results of a ca. 10% sample inventory in three study tracts. Copeland and Webster (1983) summarize a similar effort in the Trough Hollow-Emery area. The Tar Sands Class II report by Tipps et al. (1984) includes results of a sample survey in the San Rafael Swell east of Castle Valley. Reed and Chandler (1984) report on more intensive sampling in the Wasatch Plateau and Book Cliffs areas surrounding Castle Valley than that conducted by Hauck (1979a). Too numerous to list here are the small-scale surveys conducted all over the area for various energy-related developments (cf. Holmer 1982); data on sites recorded during such "clearance" surveys are included in the present analysis, however.

Because project areas overlap with the present study and were directed toward locales where coal development may take place, the most pertinent

reports with which to compare the data in this volume are those of Hauck (1979a), Thomas et al. (1981), and Copeland and Webster (1983). Of course, information from the other surveys mentioned previously will be included in the analysis presented below in Chapter 5 but, for the most part, the predictive models of site location in this report will concentrate on refining the conclusions in the three reports cited above. Initially, the BLM envisioned a three-step process in the production of separate predictive models for the Elmo and Emery Tracts. First, existing data on those two tracts ("Class I" information) would be combined with the results of inventory in the Scattered Small Tracts to generate preliminary models of site location in the larger study areas. Second, the preliminary models would be tested and refined in two stages during survey of the Elmo and Emery Tracts. Third, the models were to be finalized using the data generated in the last stage of survey in the those tracts. In MAC's technical proposal (MAC 1983:40), we suggested that the preliminary models be refined at the 5% and 10% sampling levels for the Elmo Tract and at the 1% and 5% sampling levels for the Emery Tract prior to completion of the inventory. Modelling for the Emery Tract proceeded largely as planned, but the lack of both Class I data and new Class II information for the Elmo Tract precluded development of a statistically valid interim predictive model for the latter. Instead, a descriptive summary of settlement patterns in the Elmo Tract has been written and a very tentative discriminant analysis-based model is presented (see Chapter 5).

Thus, the first step was the compilation of extant data to be used in the development of a preliminary model of site location in the Emery Tract. Searches of existing records and maps were conducted in person by the field director both at the Antiquities Section office of the Division of State History in Salt Lake City and at the BLM Resource Area office in Price. No previously recorded sites were present either in the Scattered Small Tracts or in the Elmo Tract, although a few were known from immediately adjacent areas. Data were abundant, however, for the Emery Tract; Appendix 2-7 lists those sites in the Emery Tract recorded prior to the 1984 MAC survey, not including 16 newly recorded sites from the most recent I-70 survey (Brown 1985). This table shows that 127 sites, mainly prehistoric aboriginal manifestations, had been recorded in the Emery Tract and--in combination with several other sites located just outside

the project boundaries--constituted the Class I information used to construct a preliminary model of site location in the tract. More detailed discussions of the theoretical background upon which the present model is based, and of the procedures followed in model development and testing, can be found in Chapter 3.

Known Culture History

In addition to the large-scale surveys described above, a variety of excavations at Archaic and Fremont sites have been completed, and together these data provide a wealth of information on prehistoric adaptive strategies in the Castle Valley region. Excavated sites from this area include several rock shelters and open sites with Archaic components: Clyde's Cavern (Wylie 1972; Winter and Wylie 1974), Pint-Size Shelter (Lindsay and Lund 1976), Joe's Valley Alcove (DeBloois 1979; Sargent 1977), Sudden Shelter (Jennings et al. 1980), Cedar Siding Shelter (Martin et al. 1983), the Peephole and Harvest Moon sites (Hauck and Weder 1982) and 42SV1608 (Copeland and Webster 1983). Some important Fremont sites have been excavated in the area, contributing substantially to our knowledge of the San Rafael variant. These include the Old Woman and Poplar Knob sites (Taylor 1957), the Emery site (Gunnerson 1957a), Snake Rock Village (Gunnerson 1957a; Aikens 1967), Innocents Ridge (Schroedl and Hogan 1975), Windy Ridge Village, Crescent Ridge and Power Pole Knoll (Madsen 1975a), the Old Road, Fallen Woman and Ivie Ridge Sites along I-70 (Wilson and Smith 1976), Cedar Siding Shelter (Martin et al. 1983), the Peephole Site (Hauck and Weder 1982) and 42SV1272 (Copeland and Webster 1983). Finally, Benson (1982) describes an intact prehistoric hunter's bundle of artifacts from the San Rafael Swell radiocarbon-dated at AD 1350 ± 50 (WSU-2345). Given the abundance of data from past research in and around the Castle Valley, a fairly detailed cultural history outline can be produced.

Prehistory

In Utah, no cultural remains definitively ascribed an age more than 12,000 years BP have been identified (cf. Clark 1975). This "pre-Llano" period, including what Willey and Phillips (1958:79-81) term the Lithic stage and what Haynes (1969, 1971) and Schroedl (1977a) refer to as the

Early and Middle Paleo-Indian periods, is presumed to have been a time of big game hunters exploiting the huge herbivores common in the Late Pleistocene. Closest evidence of such activities to the project area is from Wilson Butte Cave, Idaho radiocarbon dated to 14,500-15,000 years BP (Gruhn 1961, 1965); from Smith Creek Cave in eastern Nevada, dated between 11,680 and 12,150 BP (Bryan 1979); and from the Lamb Spring, Dutton and Selby sites in eastern Colorado, which are estimated to be up to 19,000-20,000 years old based on geological evidence (Stanford 1979, 1983). The existence of the purported pre-Llano "Blacks Fork Cultures" in southwestern Wyoming originally proposed by Renaud (1938, 1940) has long since been refuted by Sharrock (1966:136-142).

The earliest undisputed cultural complex in Utah is the Llano, dating to ca. 11,000-11,500 years BP in adjacent states and characterized by the fluted Clovis projectile point. Few confirmed Llano sites are reported in Utah, although several isolated projectiles suggest their presence. Schroedl (1977a:3) lists three such finds in Utah, and Black et al. (1982) report one other Clovis discovery from southeastern Utah. One possible Clovis find near the Castle Valley study area, mentioned by Schroedl (1977a), is described by Tripp (1966) from the Acord Lake area. More circumstantial evidence for a Llano occupation in Utah comes from discoveries of their main prey, mammoths (Madsen et al. 1976). Two mammoth tusk tips and mammoth dung were found in the lowest level of Cowboy Cave (Jennings 1980:9), radiocarbon dated between 11,020 ± 180 and 13,040 ± 440 BP (A-1600, A-1654). Also, presumed petroglyphs depicting mammoths are reported from near Moab (Averitt and Averitt 1947) and in Kane County (Hauck 1979b:321-322).

Following the Llano complex is the well-known Folsom complex, dating roughly between 11,000 and 10,000 BP. Folsom peoples hunted giant bison and other game to the exclusion of mammoth, which apparently had become extinct or nearly so by 11,000 BP. Folsom projectile points, like Clovis points, are fluted but are somewhat smaller and more finely flaked. The Folsom people, in addition to hunting giant bison, are presumed also to have hunted smaller game and gathered wild plants, but evidence for this is largely lacking since almost all excavated Folsom locations have been bison kill sites. Where remains other than bison bone beds have been

found, such as Lindenmeier (Roberts 1935, 1936; Haynes and Agogino 1960; Wilmsen and Roberts 1978) and Hansen (Frison 1978:118; Frison and Bradley1980), more complex tool assemblages and even a possible living surface have been recovered.

Folsom points are among the more commonly found Paleo-Indian projectiles on the Colorado Plateau (Schroedl 1977a:5), and isolated occurrences are widespread in Utah (ibid.:2). One of the only recognized Folsom sites in Utah is near the Castle Valley study area, the Silverhorn site (42EM8, Gunnerson 1956). Here, a local collector reported a Folsom point protruding from an arroyo wall. Subsequent excavations revealed 12 occupation levels in three meters of alluvial fill, but no further diagnostic material to corroborate a Folsom occupation. Shields (1968:15) indicates that two blades found at the site may be unfluted Folsoms, however. Other Folsom finds from the region are reported by Sharrock and Keane (1962) and Tripp (1967); an apparent Folsom camp, the Montgomery Site, near Green River, was recently investigated and should shed further light on Folsom lifeways on the northern Colorado Plateau (Davis 1985). Another fluted point, resembling late Paleo-Indian styles dated up to 9,600 years old at Medicine Lodge Creek, Wyoming (Frison 1983:113), has been recovered from Emery County site 42EM677 (Hauck 1979a:Figure 5-14c & d).

Increasingly warm temperatures and concomitant changes in vegetation led to changes in the characteristics of faunal populations after 10,000 years BP. Some species became extinct, such as the camel and horse, and others such as the bison were gradually reduced in size. Following the Folsom occupation, late Paleo-Indian groups continued to rely on the larger game still available and are presumed also to have collected wild plant resources. Local variations of cultural complexes characterize this period between about 10,500 and 7,500 years BP, which is called Plano (Schroedl 1977a:5-6). A wide variety of large lanceolate-shaped projectiles are diagnostic, and in the vicinity of the project area points of the Agate Basin, Hell Gap, Cody and Lake Mojave complexes are represented (Hauck 1979a:287-288, 299; Copeland and Webster 1983:57-60). The sparse settlement data available (e.g., Black et al. 1982:92) again indicate that relatively level areas with good overview qualities were preferred site locations.

Recent excavations of stratified Archaic sites, particularly caves and rockshelters, have greatly refined our knowledge of this era of hunters and gatherers between 8,300 and 1,500 years BP. Warmer temperatures and disappearance of the large Pleistocene herbivorous fauna led to the shift to a greater reliance on a variety of wild plant and animal resources that is the hallmark of the Archaic stage (Willey and Phillips 1958:104-111). Schroedl (1976:11) defines the Archaic as "a stage of migratory hunting and gathering cultures following a seasonal pattern of efficient exploration of a limited number of selected plant and animal species within a number of different ecotones". Evidence from the Great Basin, e.g., from Danger and Hogup Caves (Jennings 1957; Aikens 1970), suggests that an Archaic stage adaptation was in operation as early as 10,000 years BP (but see Madsen 1982a), well within the Paleo-Indian period as defined on the Great Plains (Frison 1978, 1983). However, the evidence from the Colorado Plateau portion of Utah--including the present study area--suggests a shorter overlap of ca. 800 years (8,300-7,500 years BP) in the shift from Paleo-Indian to Archaic ways of life.

Fortunately, a number of important Archaic sites have been excavated in central Utah, some quite close to the project area. Using most of these voluminous excavation data, Schroedl (1976) redefined the Archaic era on the northern Colorado Plateau, identifying four phases of Archaic activity. Changes in projectile point styles (Holmer 1978), subsistence practices and population were used in Schroedl's analysis, the latter estimated from radiocarbon date frequencies (1976:13-29). Earliest is the Black Knoll phase, dated between 8,300 and 6,200 years BP. Sites having Black Knoll components in central Utah are rare and include Joe's Valley Alcove and Sudden Shelter. At two caves in southern Utah Lindsay et al. (1968) and Ambler (1984) have identified what they believe to be a distinct Early Archaic culture called the Desha complex dating between 8,750 and 6,750 BP. Nickens (1982:17-18) notes similarities between the Desha complex and Great Basin material, as well as with the poorly dated Uncompahgre and La Sal complexes to the northeast (Hunt and Tanner 1960; Buckles 1971). Overall, however, the Desha complex is quite poorly understood.

Schroedl (1976:57-62) divides the Black Knoll phase into early and late subphases with the late subphase beginning about 7,200 BP. During

the early subphase, hunting of large artiodactyls is a primary subsistence activity and Pinto points predominate (Holmer 1978:67-68). Schroedl (1976:61-62) sees a contrast in subsistence between high and low elevations in which large artiodactyls are hunted in the uplands while wild plant gathering is emphasized at lower elevations. Whether this contrast represents specialization by local groups or seasonal activities of a single cultural group remains unknown. It should be noted that Black Knoll phase Pinto points of the Little Lake complex (Amsden 1935; Harrington 1957) resemble several McKean complex varieties which date between 5,000 and 3,000 BP on the Northwestern Plains (Frison et al. 1974; Frison 1978:46-50; Thomas 1983). The relationship between the Little Lake and McKean complexes in time and space, if any, has yet to be resolved (cf. Schroedl 1976:67); Green (1975) sees clear technological distinctions between the two. Earliest dates for Pinto types derive from the northern and eastern Great Basin, Middle Rocky Mountains and northern Colorado Plateau (a situation also applicable to the Elko Corner-notched point type).

In the Castle Valley phase, dated at 6,200-4,500 BP, population appears to have been lower than at any time during the Archaic on the Colorado Plateau (Schroedl 1976:63-64). Interestingly, radiocarbon dates of this age are commonly derived from Southern Rocky Mountains sites to the east (e.g., Benedict and Olson 1978:179-180; Jones 1984). Benedict and Olson (1978) attribute the population decline on the Colorado Plateau to the effects of a two-stage Altithermal drought, with populations moving to wetter "refuge" areas in the Rockies. Schroedl (1976:63-64) again divides this phase into early and late subphases, with 5,000 BP the separation point. The early subphase is characterized by population decline, a change in subsistence toward greater reliance on grasses and forbs, and the use of Rocker, Sudden and Hawken side-notched projectile points. Between 5,000 and 4,500 BP population appears to slowly rise, slab-lined firepits are common, and Hawken and Sudden side-notched, Humboldt and McKean lanceolate projectiles predominate. A population decline beginning ca. 4,500 BP marks the end of the Castle Valley phase. Sudden Shelter (Jennings et al. 1980) is one of the few Utah sites dated to this phase; the gap in radiocarbon dates between 6,200 and 5,000 BP noted by Schroedl (1976:17, 21) remains despite several recent excavations.

The Green River phase ranges in age from 4,500 to 3,300 BP and is represented by dated components at Sudden Shelter, Joe's Valley Alcove, Pint Size Shelter, Harvest Moon Shelter, the Peephole Site and Cedar Siding Shelter. Schroedl (1976:65-68) sees an early and late subphase during this time frame as well, with the early period lasting until 3,800 BP. During the early subphase population is low and diagnostic projectiles include the Gypsum and San Rafael side-notched types, except on the eastern fringe of the Plateau where McKean complex points are more common. It should be noted that the San Rafael side-notched type (Holmer 1978:69) is not a valid type in that it is identical in morphology and age to the Mallory type (also within the McKean complex) defined earlier on the Northwestern Plains (Forbis _et al_. n.d.; Lobdell 1973, 1974; Frison _et al_. 1974). Thus, the Gypsum and Elko types are the only Great Basin-related diagnostics in the Green River phase, otherwise dominated by Great Plains types. In the late subphase Gypsum points are most common, suggesting reduced Plains influence, although data are limited in this regard. In the Green River phase, hunting (especially for mountain sheep) becomes more important and amaranths are a preferred plant resource; paleo-environmental data suggest the phase was characterized by warmer, and perhaps drier, conditions (see below). The split-twig figurine complex (Schroedl 1977b) is one of the more interesting diagnostics of this phase, generally found to the south of Castle Valley.

The final Archaic phase is called the Dirty Devil phase (Schroedl 1976:68-73), ending with the introduction of the bow-and-arrow at ca. 1,800-1,500 BP. Sites dated to this phase include Joe's Valley Alcove and Clyde's Cavern, with an occupational hiatus formerly recognized between 3,000 and 2,000 BP (ibid.:68-69; Madsen and Berry 1975) that supposedly represents a population low. However, the paucity of data during the postulated hiatus has been effectively supplemented by substantial evidence from Cedar Siding and Harvest Moon Shelters. In any case, the characteristic traits of this phase include the Gypsum point type and, late in the phase, the introduction of corn. It is during this era that the transition to Formative stage culture (Fremont) occurred; indeed, many sites south of the Castle Valley project area dating as early as 2,500 BP have enough evidence of at least a semi-sedentary lifestyle to be termed Basketmaker II (e.g., Tipps _et al_. 1984:84-91). However, the presence of

Basketmaker II components north of the confluence of the Green and Colorado Rivers--as proposed at Cowboy Cave and Clyde's Cavern--should be considered with caution pending further accumulation of data (cf. Berry and Berry 1976:33-35; Berry 1982; Black et al. 1982:104, 108).

West and north of the Colorado River, Gypsum and Elko Corner-notched "points" (Holmer 1978:62-64, 70) persist in Fremont contexts well after the introduction of the bow-and-arrow (Schroedl and Hogan 1975:48; Schroedl 1976:69; Fowler et al. 1973; Hauck 1979b:316; cf. Copeland and Webster 1983:72-73). While these "Archaic" styles were perhaps used more often as knives by the Fremont (e.g., Wylie 1975), they do provide evidence of an uninterrupted Archaic to Fremont transition (Schroedl 1976:73-78). In terms of settlement, Archaic populations exploited a very wide range of environments--including sub-alpine and alpine areas--although the pinyon-juniper zone was highly favored (Hauck 1979a:240 and 269-270, 1979b:136; Black et al. 1982:129-130). Overview qualities and the presence of tool stone outcrops also attracted Archaic groups, and the occurrence of quartzite, cherts and chalcedonies in the San Rafael Swell and Castle Valley contributed to the high site densities encountered in restricted areas of the latter at and adjacent to source locales (Benson 1982:3; Holmer 1982:7; this report).

With the introduction of the bow-and-arrow, ceramics, habitation structures and domesticated plants the Formative stage began in Utah and the Four Corners states by 1,500 BP (AD 500; many habitation structures have been found in Archaic contexts in recent years, however: e.g., see Aikens 1983:246 and Tipps et al. 1984:91). Earliest dates on the introduction of corn occur in the south, where Basketmaker II sites date as early as 200 BC although most post-date AD 200 (Berry 1982). Schroedl (1976:69-73) reviews the evidence for the introduction of corn on the northern Colorado Plateau. Near the project area maize has been dated to AD 460 ± 100 at Clyde's Cavern (Winter and Wylie 1974:305); no maize was recovered from the "Fremont" component dated to AD 160 ± 100 at Pint-Size Shelter (Lindsay and Lund 1976:39).

The Castle Valley study area is within the occupation zone of the San Rafael Fremont, as defined by Marwitt (1970:137, 143-145). While Marwitt notes a general lack of absolute dates for San Rafael sites, subsequent dating ranges from AD 160 ± 100 at Pint-Size Shelter (Lindsay and Lund

1976) to AD 1190 ± 60 (Jennings and Sammons-Lohse 1981:16) at the North Point site. Tree-ring dates from Book Cliffs area sites also fall within this time span (Gunnerson 1969:167-168). Most dates range between AD 690 and 1190, supporting Marwitt's (1970:143) early assessment of an age range of AD 700-1200 for the variant (cf. Tipps et al. 1984:28). No phase sequence was proposed for the San Rafael Fremont by Marwitt due to the lack of data at the time.

However, in the past 15 years a great deal of chronometric data have become available; the radiocarbon date lists provided by Marwitt and Fry (1973) and Schroedl (1976) can be supplemented by more recent work to compile a large number of dates for the Castle Valley area. Table 2 provides such a list. When combined with information from the only other well-dated locality in the San Rafael Fremont area--Bull Creek (Jennings and Sammons-Lohse 1981)--a three-phase sequence can be postulated for this Fremont variant. The following proposed sequence should be considered a hypothetical reconstruction to be tested by future work.

If the early date from Pint-Size Shelter applies to nascent Fremont occupation, then the Dirty Devil phase of the late Archaic stage (Schroedl 1976) could be terminated at ca. 1800 BP or AD 150. The period AD 150-700 is then seen as a "Proto-Formative" phase during which horticultural practices supplemented the wild food diet, and a gradual trend toward seasonal sedentism developed (this phase can be compared to the Basketmaker II culture of the Southwest described by Berry [1982]). Diagnostic artifacts include Elko style knives, Rose Spring corner-notched arrow points and, late in the phase, plain Emery Gray pottery. The subsequent Muddy Creek phase of AD 700-1000 is characterized by increasing sedentism, a variety of dwelling structures other than those of surface coursed-masonry construction, undecorated gray ware vessels, and Rose Spring arrow points. Most Fremont sites in the Castle Valley area appear to date to this phase (Table 3), which also corresponds to radiocarbon date peaks for adjacent Fremont populations in the Uinta Basin (Marwitt and Fry 1973:4) and southwest Wyoming (Metcalf 1983:30-31).

The final Bull Creek phase at AD 1000-1200 is represented at sites such as Innocents Ridge, Snake Rock Village and the late component at Windy Ridge. Diagnostics include Anasazi trade wares, Ivie Creek Black-on-White and decorated Emery Gray ceramics, surface coursed-masonry

Table 2
Post-Archaic Radiocarbon Dates in the Castle Valley Area

C-14 Date, Years BP	Uncorrected Calendar Date, AD	Site
1790 ± 100	160 ± 100	Pint-Size Shelter
1570 ± 60	380 ± 60	Cedar Siding Shelter
1505 ± 95	445 ± 95	Snake Rock Village
1490 ± 100	460 ± 100	Clyde's Cavern
1410 ± 100	540 ± 100	Joe's Valley Alcove
1260 ± 120	690 ± 120	Windy Ridge
1220 ± 70	730 ± 70	Cedar Siding Shelter
1170 ± 250	780 ± 250	Old Woman
1170 ± 100	780 ± 100	Crescent Ridge
1170 ± 80	780 ± 80	Cedar Siding Shelter
1162 ± 250	788 ± 250	Poplar Knob
1144 ± 91	806 ± 91	Peephole Site
1060 ± 200	890 ± 200	Poplar Knob
1052 ± 200	898 ± 200	Old Woman
1040 ± 130	910 ± 130	Power Pole Knoll
1040 ± 50	910 ± 50	42Sv1272
980 ± 110	970 ± 110	Windy Ridge
910 ± 50	1040 ± 50	Cedar Siding Shelter
600 ± 50	1350 ± 50	Sitterud Bundle
330 ± 50	1620 ± 50	42Sv1609
320 ± 50	1630 ± 50	42Sv1609
150 ± 50	1800 ± 50	42Sv1609

dwellings (among other styles) and storage structures, Bull Creek and Nawthis Side-Notched arrow points and, perhaps, figurines (e.g., Gunnerson 1957b). While small Fremont sites appear to be most common for the Muddy Creek phase, during the Bull Creek phase increased effective moisture at ca. AD 950-1150 (Euler et al. 1979) may have permitted greater crop yields such that the local populations may have aggregated at fewer but larger habitations nearer to arable land. Choice of the year AD 1000 to separate the proposed Muddy Creek and Bull Creek phases was one of compromise to account for events that were not entirely synchronous. For instance, the climatic shift to wetter conditions and use of Nawthis points around AD 950 plus the use of decorated ceramics and coursed masonry construction at Windy Ridge by AD 970 ± 110 (Madsen 1975a) pre-date the phase boundary, while most Anasazi trade wares post-date AD 1050 (e.g. Ambler 1969:110).

Schroedl and Hogan (1975:54-55) also redefined the San Rafael Fremont, and in doing so place the Turner-Look and Nine Mile Canyon sites in the Uinta Fremont variant based on ceramic and settlement data:

> These sites, all located on the eastern slopes of the Wasatch Plateau, bring to light a pattern of small village sites, usually with less than a dozen dwellings per site (fewer occupied at any one time), situated on low knolls or ridges on stream channels near arable land. Emery Gray pottery predominates, but other Fremont ceramic types, as well as limited quantities of Anasazi wares, are present. Structural tendencies are for simple rock and slab-lined pit houses, often with plastered walls, without ventilators, deflectors, or crawlways; rectangular and surface dwellings, often of wet-laid masonry; and free standing storage structures (1975:54).

They assign the Turner-Look and Nine Mile Canyon sites to a new Book Cliffs phase, ca. AD 900-1200, within the Uinta variant but this proposed division has yet to be widely accepted (e.g., Jennings and Sammons-Lohse 1981:2). That Bull Creek area Fremont sites might actually represent Anasazi occupation also has been suggested (Madsen 1982b; Tipps et al. 1984:29).

Madsen and Lindsay (1977) and Madsen (1979) draw a distinction between Great Basin and Colorado Plateau Formative groups, considering them distinct cultures based on settlement and subsistence data. They call the Great Basin groups "Sevier" and Plateau groups "Fremont" (cf. Madsen 1982a). Lohse (1980) also notes Basin-Plateau distinctions but considers overall similarities too great to distinguish a separate Sevier

culture in the Great Basin. Lohse (1980), in a statistical analysis of Fremont architecture, also has found that the San Rafael variant as defined by Marwitt (1970) is a valid construct, and shows closest similarities to the Uinta variant.

> The San Rafael Fremont variant is characterized by circular, stone-lined pit dwellings, and the use of coursed masonry and adobe in rectangular surface structures. Perhaps the most distinctive single feature is the clay-rimmed, flagstone paved firepit. Only two similar firepits exist in the Fremont area, one at Evans Mound in the Parowan variant, and one at Tooele in the Great Salt Lake variant. San Rafael structures are typically built on low rises near dependable sources of water, with sites generally consisting of one or two dwellings and [m]any associated storage structures (Lohse, cited in Jennings and Sammons-Lohse 1981:138).

Highest San Rafael Fremont site density happens to be in the Castle Valley, especially along Ferron and Muddy Creeks and their tributaries. Site density is lower in the area of the San Rafael Swell and Wasatch Plateau adjoining the valley (Sargent 1977:14-15; Hauck 1979a:340; Tipps et al. 1984:Table 42). Common ceramic types found in this area include Emery Gray and Sevier Gray (R. Madsen 1977), with lesser amounts of Ivie Creek Black-on-White and both Kayenta and Mesa Verde Anasazi trade wares. Common projectile points include Uinta side-notched, Nawthis side-notched, and Bull Creek point types (Holmer and Weder 1980:57).

In conclusion, the prehistoric (pre-Ute) resources of the study area can be summarized as follows. Paleo-Indian remains are very scarce overall in central Utah. We expected to find perhaps a few isolated projectile points, mainly located on landforms affording good overview qualities of water sources. Archaic sites were anticipated to be more numerous in the Castle Valley area, with higher site densities expected in the pinyon-juniper zone on relatively level landforms, near water courses, and near tool stone outcrops. Diagnostic Archaic material is well-described in Utah (Holmer 1978; Schroedl 1976), allowing rough age determinations to be made within four phases between 8,300 and 1,800 BP.

San Rafael Fremont occupation of the project area is certain; the largest sites are most abundant on low rises next to stream courses, with more limited activity sites--such as for hunting and gathering forays--found at higher elevations in the pinyon-juniper zone. Many researchers have noted the evidence for seasonal mobility of these

Fremont populations, especially in reports utilizing large-scale survey data (e.g., Thomas et al. 1981:201; Copeland and Webster 1983:Fig. 43; Reed and Chandler 1984:85). Rock art is also present in the area (Gunnerson 1969:Fig. 25B; Berge 1973:13-14), and Pueblo IV Hopi evidence may be found anywhere in the project area but especially farther south. However, for all intents and purposes, the Formative stage ends in the study area by AD 1200, with the disappearance of the Fremont still an unsolved problem (see Marwitt 1980:11-12 and Anderson 1983, for example).

Pueblo IV (AD 1300-1600) Hopi visitation of Utah is reported by Lipe (1970) and Hauck (1979b:309); Hopi pottery is found far to the north of its core area, including near Moab (Hunt 1953; Pierson 1981:69) and even in southwestern Wyoming (48SW4962, Peebles et al. 1983a:100-101). The presence of pottery in these areas may be due to actual Hopi excursions, or to trade with Southern Paiute, Ute and Navajo groups visiting the Hopi area (Lucius 1983).

According to linguistic (e.g., Lamb 1958; Smith 1974) and archaeological data (Madsen 1975b, 1982a; Jennings 1978; Bettinger and Baumhoff 1982), migrations of Numic-speaking groups from the southwestern Great Basin began in the Late Prehistoric period with these groups (Ute and Paiute) arriving in central Utah by AD 1150-1250. Thus, Shoshonean peoples are believed to have arrived in the project area at about the same time it was being abandoned by Fremont populations (but see Goss 1965, 1968, 1977), although a cause-and-effect relationship based on this coincidence has yet to be demonstrated (Hauck 1979b:83; Nickens 1982:36). Some researchers (e.g., Gunnerson 1962, 1969:181-193) see the Fremont as the ancestors of the Utah Shoshoneans, but this interpretation is wholly unresolved. Desert side-notched projectile points (Holmer and Weder 1980:60) are considered diagnostic of the Numic spread in Utah, and date between AD 1150 and the historic era.

Both the Utes and Paiutes followed an Archaic stage lifestyle based on hunting and gathering, although the Eastern Ute (east of the Colorado and Green Rivers) enhanced their mobility greatly through acquisition of the horse after the Pueblo Revolt of 1680 (Stewart 1966). Subsistence resources included a wide range of plants and animals (e.g., Wheat 1967), with small brush shelters (Euler 1966; Smith 1974; Jennings 1978) commonly constructed as temporary dwellings. Though archaeologically the Utes and Paiutes are difficult to distinguish, territorially the Utes occupied the

Castle Valley with Southern Paiute groups found farther south (Stewart 1966; Euler 1966:4-5; Janetski 1982). Some overlap is to be expected, of course, given the close genetic relationship of the two groups. Numic sites are not numerous in the project area (Sargent 1977; Hauck 1979a) and given the dearth of data few comments on settlement patterns can be offered. The Sitterud Bundle from the San Rafael Swell (Benson 1982) is a hunter's tool kit dated at AD 1350 $\pm$ 50 that may represent early Ute occupation of the area, but no diagnostic material is present. Three late radiocarbon dates from 42SV1609 (Copeland and Webster 1983:105-108) may also apply to a Ute occupation.

History

The history of the study area is summarized by Jorgensen (1955), Mauerman (1967), Hauck (1979a:76-98), Poll et al. (1978), the Emery Historical Society (1981), and Weathers and Rauch (1982). The first well-documented visit to Utah by an Anglo group was the famous Dominguez-Escalante expedition of 1776-77. Their route bypassed the project area to the north and west, but their journey was an important step in the exploration of Utah. Few other Euro-Americans traversed Utah in the following decades until the advent of the fur trade in the West, mainly between 1810 and 1840. Two of the more important events connected with this activity were the establishment of the Old Spanish Trail, in use through southern Castle Valley between 1829 and 1860 (especially the period 1830-1848; Crampton 1979), and the founding of Fort Roubidoux in 1837. Among the more important figures in Utah during this period were Antoine Roubidoux, William Wolfskill, Ewing Young and Jedediah "Peg-Leg" Smith. Changes in fashion and depletion of beaver populations led to a rapid decline in the fur trade, and by 1845 the era had ended.

Soon after, however, further explorations by government and Mormon expeditions heralded the opening of Utah to white settlement. Beale, Gunnison and Fremont all traversed the Utah region in 1853, including the Castle Valley area. The previous year, 1852, saw the first successful mining venture in southern Utah as iron was produced at Cedar City; Gunnison noted the presence of coal east of present-day Emery on his 1853 journey (Hauck 1979a:84). Three other expeditions in the 1850s that crossed central Utah were the Huntington exploration party in 1854, the Elk Mountain Mission in 1855 and the Macomb-Newberry journey of 1859.

The following decade witnessed the expansion of two important industries in Utah, mining and ranching. Ranching was initially carried out in central Utah in 1864 in the Henry Mountains, although the business didn't boom until the mid-1870s. Also in the Henry Mountains, mining and prospecting for gold was initiated in 1868 by Burke and Bowen. The famous river trips of John Wesley Powell followed in 1869 and 1871-72, the latter expedition including an exploration of the Henry Mountains.

The decade of the 1870s was a boom time for the ranching and mining interests in Utah. In 1873 Agustus Ferron's township survey in the Castle Valley area related the settlement potential of major drainages here to future settlers residing along the Wasatch Front (Mauerman 1967:42). Coal was first mined at Connellsville and the Pleasant Valley in 1875, leading to a coal mining boom throughout the Castle Valley-Price area. The arrival of the Denver and Rio Grande Railroad to that area in the early 1880s provided further impetus to the coal boom there. The desire to establish new agricultural communities resulted in the settling of the Castle Valley by 1878; the valley and areas south rapidly grew in population, resulting in the founding of Castle Dale, Ferron, Huntington and Price by the end of 1879 and the formation of Emery County in 1880 (Poll et al. 1978:150).

Interest in coal mining, as noted above, received a boost when railroads reached the Price-Pleasant Valley area in 1883. In fact, "the railroad companies almost totally dominated the ownership and production of the Utah mines until the early 1900s" (Hauck 1979a:86). After 1910, however, numerous independent companies sprang up and the coal industry of central Utah boomed through the mid-1920s. A combination of overdevelopment, rising costs, and the depressed economy resulted in a slowdown and the closure of several mines in the period between the late 1920s and World War II. One last boom before the present expansion of coal mining came during WWII and the prosperous years following in the late 1940s-early 1950s (Hauck 1979a:87-90).

Ranching expanded greatly after 1880 and before the establishment of the National Forests restricted grazing rights. However, in the late 1880s and early 1890s, a substantial shift to sheep ranching from cattle ranching spread through the area. In that former cattlemen were shifting to sheep, rather than new sheep ranchers moving into cattle territory, the

change to sheep ranching was not as violent as in other areas of the West (cf. Weathers and Rauch 1982:25-26). The 1890s also saw a second influx of settlers interested in an agricultural lifestyle. The Elmo-Cleveland area was inhabited at this time, as were two other small villages that no longer exist: Desert Lake and Victor. These two settlements in the valley of Desert Seep Wash adjacent to the Elmo Tract were founded to take advantage of irrigation water provided by a reservoir in the valley. However, problems with water salinity soon appeared and the two towns quickly faded into history.

Thus, the main industries of the Castle Valley area have been ranching, mining and agriculture. In the project area historic sites of all these industries, except probably agriculture, can be expected to be found (most agricultural property is privately-owned in the Castle Valley). Homesteads, ranching camps and mining sites were expected to be the most commonly encountered sites; see Chapter 4 for a discussion of the historic site types found during the present survey.

CHAPTER 2

Environment

Paleoenvironmental Reconstruction

Before presenting a description of present environmental conditions in the Castle Valley area, a summary discussion of paleoenvironmental studies is in order. Data are rather sparse for the northern Colorado Plateau as a whole, so the general outline presented by Currey and James (1982) for the northeastern Great Basin will be used in combination with information from the Castle Valley area and from the region as a whole (Wright 1983). The Holocene record is divided into three stages by Currey and James (1982:29): the Late Pluvial stage between 12,500 and 7,500 BP; the Postpluvial stage of 7,500-5,000 BP; and the Neopluvial stage covering the past 5,000 years (ages in radiocarbon years before present).

During the Late Pluvial, post-Pleistocene warming resulted in the upward movement of the subalpine treeline as well as the gradual reduction of playa lakes in the Great Basin. A brief glacial advance in higher elevations is recognized in many mountain ranges between 11,000 and 10,000 BP, which correlates with the relatively wet Lubbock Subpluvial interval of 10,500-10,300 BP on the Southern Plains (Wendorf 1970), but by 7,000 BP the ice age-adapted megafauna hunted by Paleo-Indian groups had disappeared (Grayson 1984, 1982:84).

The Postpluvial stage coincides generally with the Altithermal climatic episode as defined by Antevs (1948, 1955) and, indeed, reduced effective moisture in combination with further warming seems to indicate a regional drought especially in the period ca. 6,000-5,500 BP, with peak dryness at about 5,700 BP (cf. Benedict 1979, 1981). The timing of peak dryness varied during the Postpluvial, however; on the Plains the period 7,500-6,000 BP was driest while in the Southwest the effects were delayed until the late Holocene, i.e. post-4,500 BP, and at Snowbird Bog, Utah the warm interval dates to 8,000-5,200 BP (Madsen and Currey 1979).

The Great Basin, northern Colorado Plateau and Central Plains apparently were most affected by this climatic episode, while warm but wet conditions prevailed in other areas such as the Pacific Northwest, Middle and Southern Rocky Mountains, southern Southwest and extreme Southern Plains. Knox (1983:38) summarizes the situation thusly:

> Between about 10,000 and 8000 yrs BP, most regions were rapidly becoming warmer and drier and valley alluviation was dominant. The magnitude of valley alluviation generally increased westward in parallel with increased drying and increased vegetational change. Between about 8000 and 7500 BP, valley alluviation apparently was interrupted by erosion that was relatively minor in the East and the humid Midwest but very significant in the Southwest. Between about 8000 and 6000 yrs BP, valley alluviation apparently slowed in the northern West, the Midwest, and the East, but in the warm/wet Southwest major erosion of valley fills occurred....
>
> Between about 6000 and 4500 yrs BP, significant erosion of early-Holocene alluvial fills was occurring in most regions, except in the Southwest, where active alluviation prevailed.

Referring to vegetational history rather than alluvial chronologies, Baker (1983:124) presents a geographically more detailed breakdown for the West:

> A warmer Altithermal climate is strongly suggested in western and eastern Washington, southwestern Montana, Yellowstone Park, and southeastern Idaho. This climatic warming seems to have occurred later and lasted longer in sites at low versus high elevations. Sites in the Bighorn Mountains and in southwestern Colorado show little evidence for change in Holocene vegetation and climate, perhaps because they are not from ecologically sensitive areas. Progressive warming from the late glacial through the entire postglacial seems to characterize lowland sites in Colorado and California, and a wetter Altithermal is indicated for the Chihuahuan Desert of western Texas and New Mexico.

In the Castle Valley area Postpluvial and Neopluvial data are available from Joe's Valley Alcove (Schoenwetter 1974), Clydes Cavern (Winter and Wylie 1974), Pint-Size Shelter (Lindsay 1976), Sudden Shelter (Baerreis 1980; Lindsay 1980a), Cowboy Cave (Spaulding and Petersen 1980; Hewitt 1980; Lindsay 1980b), Harvest Moon Shelter (Scott 1982) and Cedar Siding Shelter (Scott 1983). In combination this information can be used to delimit four major stages in the Holocene environmental record for this portion of Utah: the warmer Altithermal episode between 8,700 and 4,900 BP; a brief cooling period at 4,900-4,600 BP; another warm, probably dry interval from 4,600 to 3,400 BP; and a general cooling trend for the past 3,400 years. Within that span, however, local fluctations were common (e.g., Euler et al. 1979).

During Altithermal warming, relatively moist conditions were present at Sudden Shelter until at least 6,300 BP with a peak in effective

moisture at about 6,700 BP, and drying conditions after ca. 6,000 BP. The moist conditions seen at this site prior to 6,300 BP can be duplicated elsewhere in the higher elevations of the region, such as the Ptarmigan glacial advance of 7,250-6,600 BP documented by Benedict (1981) in the northern Colorado mountains. Significantly, the entire period 8,700-5,000 BP at Cowboy Cave appears to have been both warm and dry, and lower arboreal pollen levels with a predominance of juniper over pine are seen at a possible pre-6,000 BP level in Harvest Moon Shelter (Scott 1982). The implication of these data for the Castle Valley area is that the Postpluvial stage was relatively warm throughout the region, but higher elevations of the Wasatch Plateau adjoining the Valley remained fairly moist until 6,300-6,000 BP and significantly dry conditions were confined to the lower elevations of the Valley, particularly between 6,000 and 5,000 BP.

The Neopluvial stage of the past 5,000 years has been a time of fluctuating climates, as exemplified by the Neoglacial sequence defined by Benedict (1981) and the tree-ring record for the Southwest (e.g., Euler et al. 1979). At Sudden Shelter, the most significant increase in effective moisture occurred at 4,900-4,700 BP, which Lindsay (1980a:265) believes was due to one or more of three conditions: increased annual precipitation, a change in the seasonality of precipitation or decreased temperatures. This first stage of Neopluvial cooling and/or increased moisture corresponds to the early Triple Lakes glacial advance of 5,000-4,000 BP identified in many mountain locales. The warmer interval at 4,600-3,400 BP was a time of population expansion in large areas of the West (e.g., the widespread McKean complex appears at this time), and it has been suggested that denser pinyon pine forests did not become established in this area until the end of the first Triple Lakes event (see Hewitt 1980:135; cf. Madsen 1982a:208-210). Both warm and dry conditions for this period are suggested at Pint-Size Shelter based on decreased pine pollen levels.

A second peak in effective moisture at 3,400 BP in Sudden Shelter is paralleled by an indication toward cooler temperatures beginning at ca. 3,300 BP at Cowboy Cave; this corresponds nicely with the second stage of Triple Lakes glaciation dated at 3,300-3,000 BP by Benedict (1981). Most researchers in this field also agree that vegetation zones in the region

have remained fairly stable for the past 4,500-4,000 years. Nonetheless, small-scale environmental changes did take place, as the post-3,300 BP contrast in records at Sudden Shelter and Cowboy Cave indicate. At the latter site, the second stage of Triple Lakes cooling is accompanied by relatively moist conditions until a drying trend begins by 1,900 BP. On the other hand, the more mesic Sudden Shelter location was largely abandoned by 3,300 BP perhaps due to this cooling trend, but perhaps exacerbated by gradually drier conditions as well throughout the entire period rather than only in the post-1900 BP era.

Brubaker and Cook (1983:226) summarize the Neopluvial record for the White Mountains of California based on the tree-ring studies of La Marche (1973, 1974), a record that shows surprising synchroneity with events on the northern Colorado Plateau:

> The paleoclimatic interpretation of bristlecone-pine ring patterns has centered on sites in the White Mountains. LaMarche (1974) establishes a 5405-year-long chronology from the upper treeline and concludes from physiologic and response-function studies that this chronology is a record of warm-season temperature. Interpreted in terms of temperature, this chronology indicates that relatively warm summers prevailed in the southwestern United States during the periods 5500 to 3300 yr BP, 2000 to 1950 yr BP, 800 to 600 yr BP and 100 yr BP to the present. Cool conditions were common during the periods 3300 to 2000 BP, 1700 to 800 BP, and 600 to 100 yr BP.
>
> On the basis of positions and ages of living and dead trees, LaMarche (1973) also describes past changes in the elevation of the upper treeline in the same area. The treeline was 150 km [sic] higher than it is at present 5500 to 3500 BP, but it decreased in elevation 3500 to 2500 yr BP and again 900 to 500 yr BP. Since warm-season temperatures presumably limit the position of the upper treeline in this area, these elevation changes corroborate the temperature interpretation of ring-width variations.

Both warming and cooling episodes correspond to climatic changes in the Utah area; note the onset of cooler conditions at 3,300 BP, and the 2,000-1,950 BP warming vs. the drying episode starting 1,900 BP at Cowboy Cave. Similarly, Benedict (1981) recognizes the Audubon glacial advance of 2,400-900 BP and Arapaho Peak ("Little Ice Age") advances of 350-100 BP in the Colorado mountains, while Madsen and Currey (1979) note a general cooling trend for the past 3,500± years at the less sensitive Snowbird Bog locality. In the Southwest, Euler <u>et al</u>. (1979:1094-1098) identify

drought culminations at 240 BC, AD 50, 350, 600, 875 and 1450, with increased effective moisture in the general time spans AD 450-750 and 950-1150.

Thus, paleoenvironmental research is beginning to result in a regionally consistent interpretation of major environmental trends on the northern Colorado Plateau, albeit much more work needs to be done (Table 3). It has become obvious, on the other hand, that significant differences in environmental conditions are possible on the local level. For instance, it seems quite likely that middle Holocene warming (i.e., the Altithermal episode) had a more deleterious effect in terms of decreased effective moisture on low-lying portions of the Castle Valley area such as the Elmo Tract, than on the higher elevation zones of the Wasatch Plateau or the Molen Reef-Mesa Butte area in the Emery Tract (e.g., Copeland and Webster 1983:137). Post-Pleistocene warming was initiated by 13,000- 12,000 BP, with gradually drying conditions after 8,700 BP that peaked about 6,000-5,500 BP; locally moist conditions occurred around 6,700 BP. After a brief cool and moist period between 4,900 and 4,600 BP a warm, mostly dry interval ensued until 3,400 BP when a cooling trend again began. This cooling episode has been fairly dry as well, especially over the past 2,000-1,900 years, but conditions largely similar to the present environment have been established in the Castle Valley area probably since 4,600 BP.

In Table 3, it is apparent that cultural phase boundaries as defined by Schroedl (1976) and the present authors correlate in a general way with environmental changes. The Black Knoll-Castle Valley phase transition at 6,200 BP shortly follows a shift to drier conditions at Sudden Shelter ca. 6,300 BP. Early and late subphases of the Castle Valley phase are separated at 5,000 BP when most workers recognize the onset of cooler, wetter weather. By 4,500 BP this cooler interval had ended, as does Schroedl's (1976) Castle Valley phase. The subsequent Green River phase terminates at 3,300 BP when cooler climates again ensue over a wide area. The proposed Muddy Creek-Bull Creek phase change at AD 1000 (this report) is partially based on a shift to increased effective moisture beginning ca. AD 950 (Euler _et al_. 1979). However, not all phase boundaries are synchronous with climatic changes: the initiation of the Black Knoll, Proto-Formative and Muddy Creek phases, as well as the

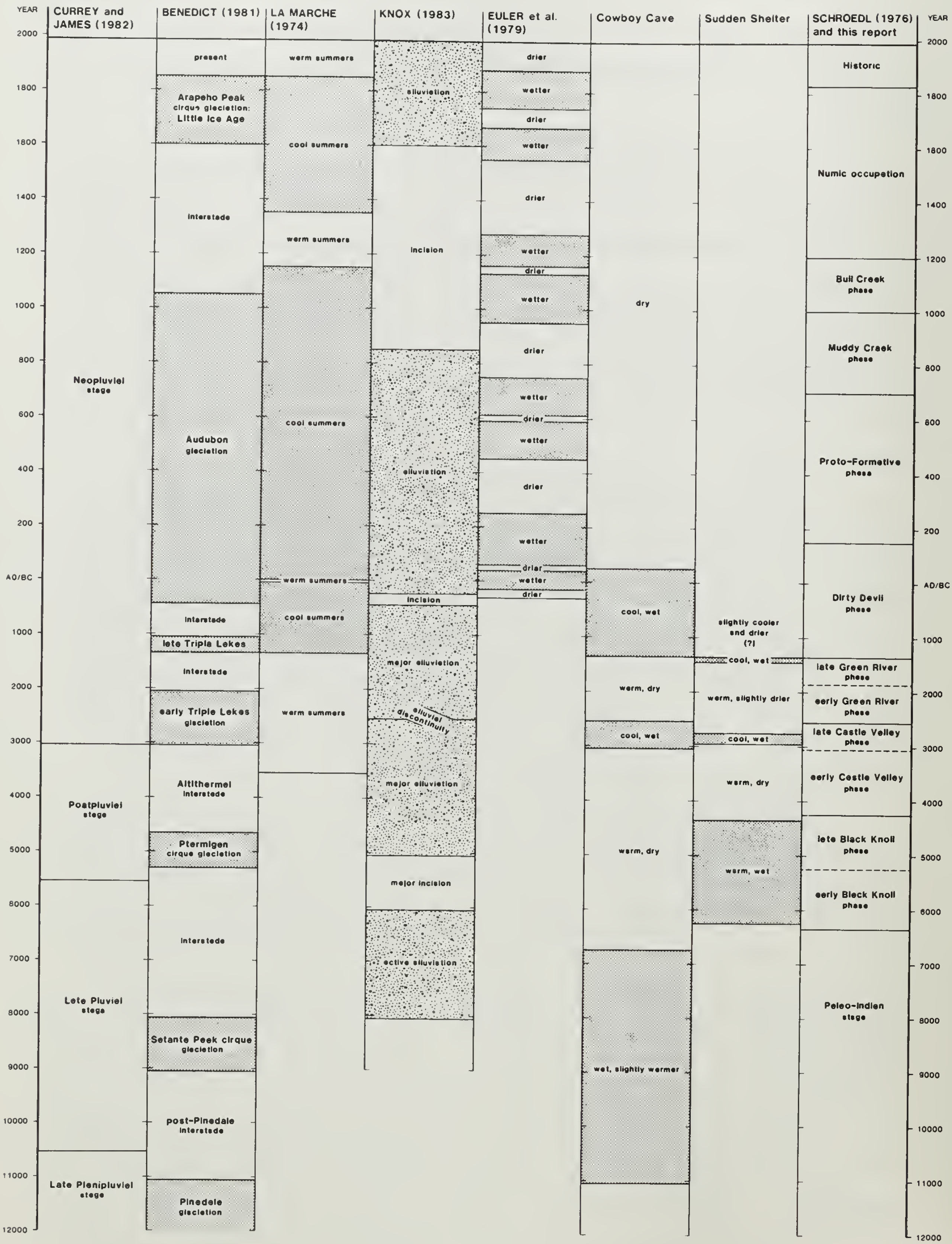


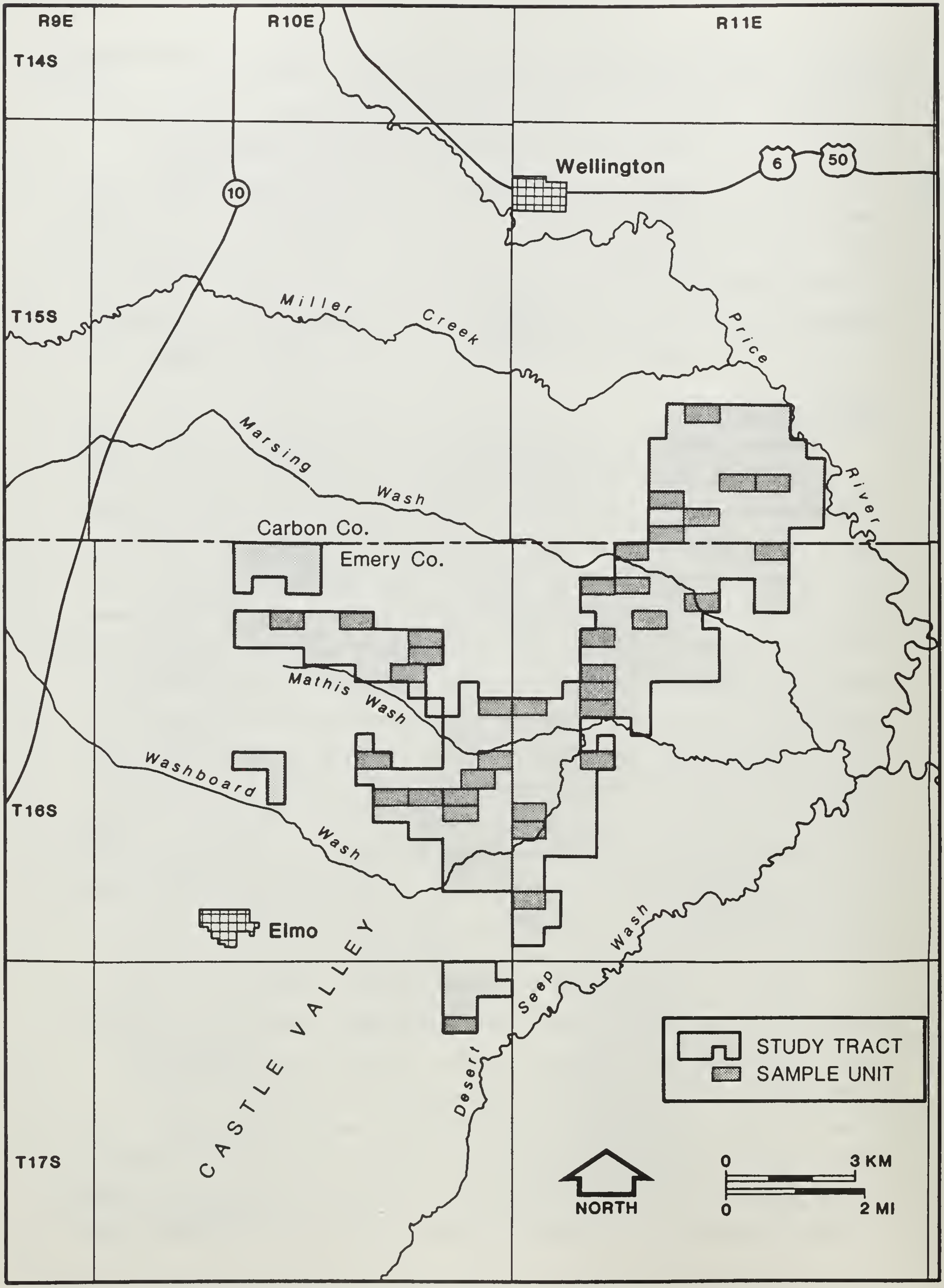
Table 3. Correlation of Paleoenvironmental and Cultural Reconstructions

termination of the Bull Creek phase, are placed strictly on archaeological grounds. Indeed, we caution against a "deterministic" view of environmental change vs. culture change; it is extremely unlikely that climatic factors were solely responsible for the Archaic-Fremont or Fremont-Numic transitions, for instance. In short, we see environmental change as contributory to, rather than the sole cause of, culture change. Adjustments in settlement-subsistence systems certainly were necessitated by climatic shifts but, given the conservative nature of most cultures, wholesale changes were likely only if other stresses were simultaneously in effect (e.g. competition, population pressure, internal strife, etc.).

Present Conditions

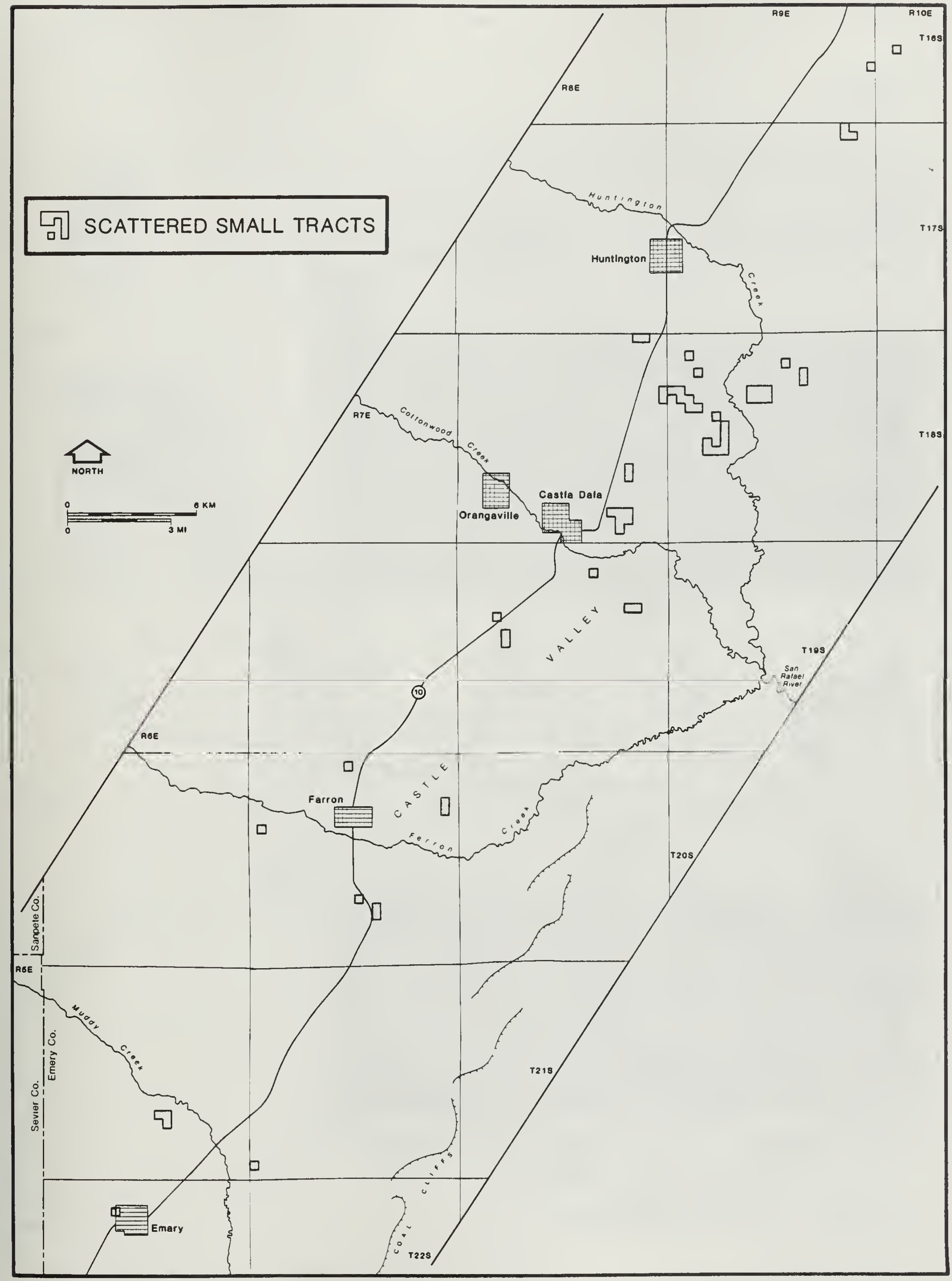
The Castle Valley project area with its three study tracts is located at the northwest edge of the Canyonlands Section of the Colorado Plateau physiographic province (Thornbury 1965:416), in the Mancos Shale Lowland subsection as defined by Stokes (1977). Of the three study areas, the Elmo Tract is farthest north (Figure 2) in the Elmo-Cleveland area; the Scattered Small Tracts occur over a wide area between the towns of Elmo and Emery (Figure 3); and the Emery Tract covers a largely contiguous zone south and southeast of the town of Emery (Figure 4). Topographically, these tracts are fairly similar, characterized by flat-lying to gently tilted sedimentary rocks forming low mesas and cuestas of sandstone and wide, flat valleys and canyons underlain by softer shales. More open, slightly rolling terrain is typical of the Elmo Tract (Figures 5 and 6), while mesas and canyons bounded by vertical cliffs and steep talus above the floor of Castle Valley are prevalent in the Emery Tract, and western and southern parcels of the Scattered Small Tracts (Figures 7-10). Elevations are in the 5,300-5,800 ft (1,615-1,768 m) range in the Elmo Tract; between 5,600 and 7,125 ft (1,707-2,171 m) in the Emery Tract; and generally 5,500-6,500 ft (1,676-1,981 m) in the Scattered Small Tracts. Lowest elevations in the project area are along the major local water courses--the Price River, Muddy Creek and the lower reaches of the headwater creeks forming the San Rafael River--while highest lands are to the west and south on Molen Reef, Mesa Butte and the Saleratus Benches.

The geologic formations prevalent in the study area are fairly limited in number compared to the diversity present in the more extensive region



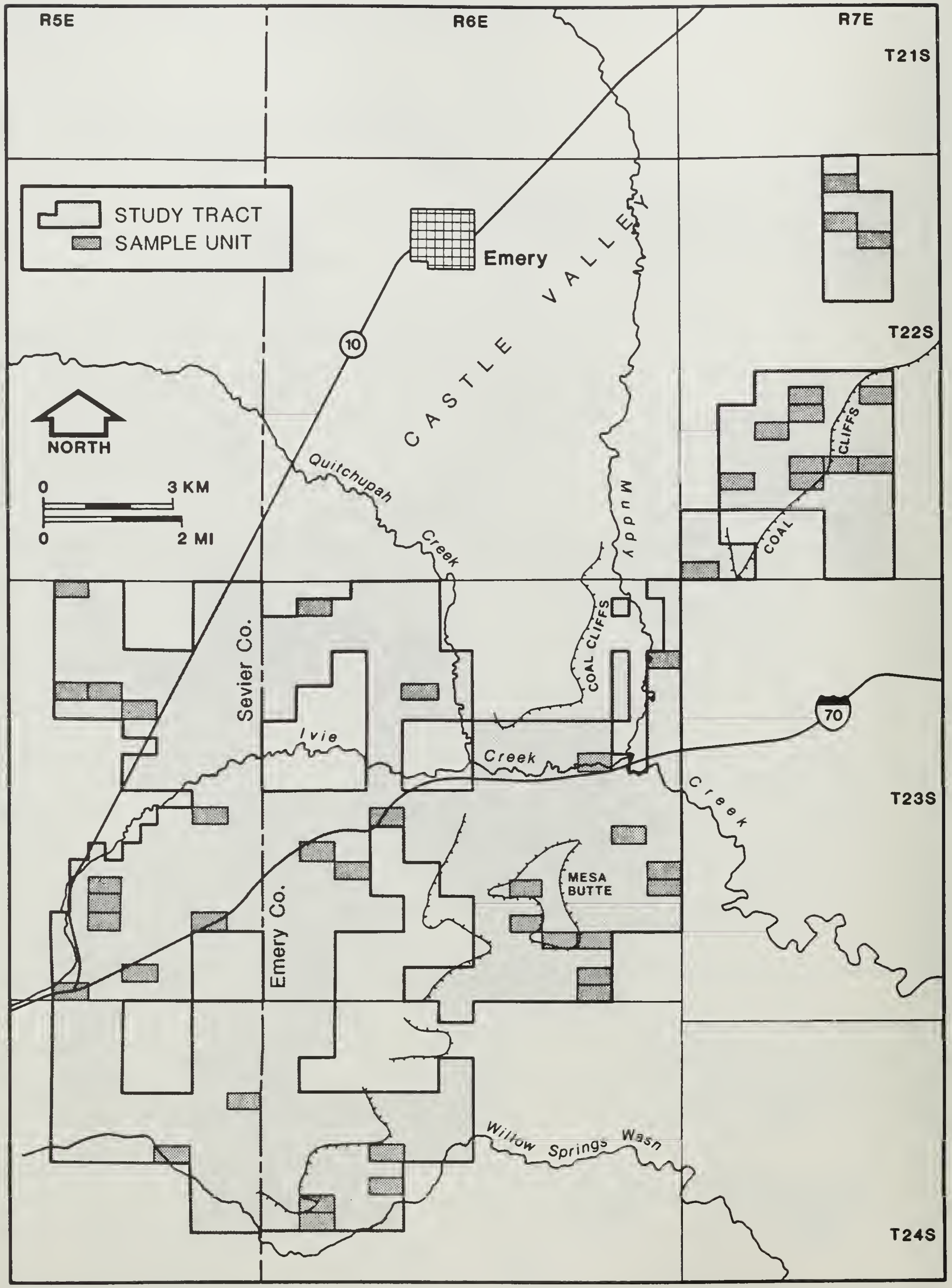
ELMO STUDY TRACT

FIGURE 2



SCATTERED SMALL TRACTS

FIGURE 3



EMERY STUDY TRACT **FIGURE 4**

FIGURE 5

View looking east from the southeast corner of unit 19 in the Elmo Tract, showing mesa rim on west side of Price River valley. The Book Cliffs are on the horizon. Roll MA-22-84, neg. #0.

View looking southeast toward confluence of Mathis Wash and Washboard Wash, from east edge of unit 94 in the Elmo Tract. Roll MA-23-84, neg. #8A.

FIGURE 6

FIGURE 7

View looking south-southeast in unit 13 of the Scattered Small Tracts, showing subdued terrain in salt desert area in vicinity of sites 42EM2075 and 2076. Roll MA-101-83, neg. #5.

View looking southwest at masonry structure (foreground) and mesa-canyon terrain in Scattered Small Tracts unit 20 near Ferron. The site is a butte top Fremont habitation, 42EM2066, the escarpment of the Wasatch Plateau forms the backdrop. Roll MA-17-83, neg. #16A.

FIGURE 8

FIGURE 9

View looking southeast down canyon of Willow Springs Wash in Emery Tract unit 421. Roll MA-14-84, neg. #4A.

View looking north-northeast toward Walker Flat and grassy, gentle terrain on north side of Ivie Creek Bench in unit 259 of the Emery Tract. Figure in foreground sits within area of hillside site 42SV2047. Roll MA-13-84, neg. #15.

FIGURE 10

covered by Hauck (1979a). For the most part the interbedded sandstone and shale units of the Cretaceous Mancos Shale are most common, with more limited exposures of the late Jurassic Morrison formation and the early Cretaceous Cedar Mountain-Dakota formation sequence present only in the Emery Tract east of the Coal Cliffs (e.g., Stokes and Cohenour 1956; Williams and Hackman 1971; Hintze 1980, 1981). Late Tertiary (Miocene-Pliocene) extrusive igneous rocks of vesicular basalt cover small portions of the Emery Tract around and south of Interstate 70, while pediment gravels of Quaternary age cap the surface of hills and mesas especially in the area between Elmo and Ferron. These gravels were of some importance prehistorically as a source of microcrystalline silicate tool stone such as cherts and chalcedonies (e.g., Thomas et al. 1981:97, 189). Of similarly limited distribution is the Quaternary and Recent alluvium which fills valley bottoms in patchy locations throughout Castle Valley.

As was just mentioned, the Mancos Shale is by far the most prevalent formation in the study area, but its constituent units are not evenly distributed in the three study tracts. The alternating shale and sandstone units of the formation show that the Castle Valley area was at the western edge of the Cretaceous sea which formed it, with shale units representing times of higher sea levels and sandstone units marking beach sands during retreats in the sea level. Generally speaking, older units of the Mancos formation are more prevalent in the Elmo Tract and younger units in the Emery Tract, but this distinction is of little importance in terms of aboriginal settlement preferences. The sandstone outcrops together have more archaeological sites than the shale, pediment gravel and alluvium outcrops combined but this trend may be due more to vegetation than to geology (i.e. the distribution of pinyon-juniper forest largely coincides with outcrops of sandstone). This circumstance is discussed in more detail in Chapter 5. From oldest to youngest, the named units of the Mancos Shale are the Tununk shale, the Ferron sandstone, the Blue Gate shale, the Emery sandstone, and the Masuk shale (Hintze 1980). Coal beds are exposed in the Mancos Shale mainly within and adjacent to sandstone units such as the Ferron member, which caps Molen Reef and whose escarpment there is named the Coal Cliffs for obvious reasons (Hauck 1979a:41). Fossiliferous outcrops in the Castle Valley area include floral remains from the Blackhawk (Mesa Verde group), Dakota, Cedar

Mountain and Morrison formations (Tidwell 1975); and faunal specimens from the Blackhawk, Ferron, Tununk, Blue Gate, Dakota and Morrison units (Katich 1956; Lindsay and Rauch 1982).

Soils within the project area have developed through a combination of five factors: climate, organisms, topography, parent material and time (Birkeland 1984:162). These soils are generally classified as Aridisols and Entisols, especially Orthents and Orthids (ibid.:55-56; Hutchings and Murphy 1981), meaning they are shallow and weakly developed soils too dry to exhibit significant horizonization such as a topsoil zone or subsurface accumulation of clay. Textures are largely controlled by parent material (i.e. local bedrock), with sands and sandy loams on sandstone units, siltier soils in alluviated settings and clayey textures where shale is at or near the surface. These alluvium, colluvium and residual soils are common in the project area, with some aeolian sediments contributing to these soils in certain areas, especially, of the Emery Tract. For instance, low sand dunes have formed on the terrace surface next to Ivie Creek at Snake Rock Village (see Chapter 4). Swenson et al. (1970) have mapped the soils of the Castle Valley area, and note that Typic Torrifluvents, Typic Torriorthents and Xerollic Calciorthids are most common.

The climate of the project area ranges from arid to semi-arid, depending on elevation, as the Wasatch Plateau to the west acts as an effective rainshadow. Annual precipitation averages around eight inches (ca. 20 cm) at lower elevations and about twelve inches (30.5 cm) in more elevated areas, approximately half of which falls in summer thunderstorms (Hauck 1979a:11-12). Temperatures show wide variations both diurnally and annually. Summer days are very hot, often exceeding 100° F (43° C) in low-lying areas, but summer nights are pleasantly cool; winters are cold but not especially snowy, averaging 10-20 inches per year. The average frost-free period ranges from ca. 120-160 days in the lowlands to less than 100 days above 6,500 ft. Table 4 summarizes climatic data from the area, and is compiled from Swenson et al. (1970:74-75), Murphy (1981), Richardson (n.d.), and Richardson et al. (1981).

Because of heavy winter snows on the Wasatch Plateau, streams which head in that area and descend eastward to cross the arid Castle Valley provide a dependable water supply at intervals averaging 8-12 miles (13-19 km) on a northeast-southwest line down the length of the Valley. From

north to south these major streams are the Price River, Huntington Creek, Cottonwood Creek, Ferron Creek, Muddy Creek, Quitchupah Creek and Ivie Creek. All these streams directly or indirectly flow into the Green River, the indirect routes being via the San Rafael and Dirty Devil Rivers. Other tributary drainages worth mentioning include Washboard Wash and Desert Seep Wash in the Elmo Tract; Rock Canyon Creek amidst the Scattered Small Tracts; and Willow Springs Wash, South Salt Wash, Saleratus Creek, Trough Hollow and Oak Spring Creek in the Emery Tract.

The project area lies almost entirely within the Upper Sonoran vegetation zone, i.e., the "pinyon-juniper belt" (Elmore 1976:13), contributing to a less complex situation in terms of floral communities represented than that described by Hauck (1979a:13-25). The latter's terminology will be retained here, however. Within the Upper Sonoran zone four main communities are present in the study tracts: Desert Shrub, Big Sagebrush, Pinyon-Juniper and Riparian (ibid.:14-15; Tidestrom 1925; Cronquist *et al*. 1972; Harris 1983).

Table 4

Climatic Summary for the Castle Valley Area

Town	Elev (ft)	Avg. Temperatures (°F) Jan Min.	July Max.	Avg. Precip(") Aug.	Nov.	Annual	Avg. Winter Snowfall(")
Emery	6,250	11.2	82.9	1.25	0.35	7.50	22.8
Price	5,565	9.1	90.2	1.23	0.54	9.77	25.2

The Desert Shrub association includes four subtypes, i.e. spatially restricted areas dominated by one of the following: greasewood (*Sarcobatus vermiculatus*), mat saltbush (*Atriplex corrugata*), shadscale (*Atriplex confertifolia*) and blackbrush-Mormon tea (*Coleogyne ramosissima* and *Ephedra* spp.). The greasewood community prefers dry alkaline soils, especially terraces in valley settings, and is present in almost pure stands in all three study tracts--e.g., along Washboard Wash in the Elmo Tract. Mat saltbush (a.k.a. "Castle Valley clover") also is commonly seen in almost pure stands on alkaline soils, but grows more sparsely and prefers the drier, clayey soils in the Mancos Shale badlands. This vegetation type is prevalent in the driest areas of the Elmo and

Scattered Small Tracts, but is uncommon in the Emery Tract. Shadscale is generally seen in more diverse plant communities, where soils are dry and alkaline, but less clayey than the decomposed shale preferred by mat saltbush. The shadscale community covers wide areas of the Elmo Tract, and smaller portions of the other two tracts; "dry meadows" dominated by grasses (e.g., curly grass) interfinger with shadscale-dominated communities in many places. The blackbrush-Mormon tea association is most prevalent where sandstone rather than shale is at the surface, but in the Emery and Scattered Small Tracts it is almost always an understory association in pinyon-juniper woodlands. Yucca, rabbitbrush, snakeweed, prickly pear cactus and various grasses are common in this zone, which is absent in the Elmo Tract.

The Big Sagebrush community includes both dry meadows dominated by grasses (e.g., blue grama and galleta grass) and shrublands with locally dense stands of big sage (*Artemisia tridentata*). Most often, the community is a diverse one with a variety of other shrubs, grasses and forbs present such as rabbitbrush, snakeweed, horsebrush, winter fat and bitterbrush. Characteristically, well-drained sandy soils are preferred, as this community is most common in the Emery and Scattered Small Tracts where it often forms open "parks" amidst the pinyon-juniper forest.

The Pinyon-Juniper zone is often considered the most important element of the Upper Sonoran communities, largely due to the impact of Steward's (1938) ethnographic analysis of Shoshonean lifeways in the central Great Basin. As mentioned above, some have raised doubts about how common pinyon pine was in the northern Basin-Plateau area prior to the onset of Neoglaciation ca. 5,000 years ago (Hewitt 1980; Madsen 1982a); pollen data and packrat midden studies show that pinyon-juniper forests were established in the Southwest by 8,000 BP (e.g., Van Devender and Spaulding 1979; Baker 1983:122-124). Whatever the prehistoric sequence, pinyon- juniper woodlands are now widespread in the Emery and Scattered Small Tracts on well-drained sandy soils, especially above 6,000 feet. Common understory plants include blackbrush, bitterbrush, mountain mahogany, cliffrose, serviceberry, yucca, sagebrush, Mormon tea, snakeweed, rabbitbrush, grasses and forbs. In the higher elevations of the project area like Molen Reef, the Saleratus Benches and Mesa Butte in the Emery Tract, the transition to the mountain scrub association is

approached at the upper limit of the Upper Sonoran zone. In these few areas above about 6,500 ft the blackbrush-Mormon tea community is nearly co-dominant with the woodland species, and roundleaf buffaloberry (_Shepherdia rotundifolia_) makes its only contribution to the local flora.

The Riparian community is not included in Hauck's (1979a:13-22) discussion of Upper Sonoran flora, but is of sufficient importance to note here. This community provides the only deciduous trees in the project area--the cottonwood (_Populus_ spp.) and Russian olive (_Elaeagnus angustifolia_, an introduced species)--and is dependent on a permanent water supply at or near the surface. Thus, the major streams mentioned previously support riparian growth except where arroyo-cutting has significantly lowered the local water table. Such a circumstance can be seen along Interstate 70 in the Emery Tract, where dead cottonwoods on a high terrace stand as evidence of Historic period downcutting by Ivie Creek. The riparian community is most prevalent in the Emery and Scattered Small Tracts, where willow and tamarisk also occur along streambanks. In the Elmo Tract and drier parcels of the Scattered Small Tracts, more alkaline conditions result in occasionally dense stands of salt grass in the bottom of some drainages, but cottonwood trees are more prevalent along irrigation ditches than along most drainages.

Fauna of the project area include the prominant big game animals like mule deer, bighorn sheep, antelope and elk, with moose and bison available in the past (a possible bison skeleton was observed in an arroyo cut near 42EM2052 at Marsing Wash). Rabbits, hares, squirrels, prairie dogs, porcupines, sage grouse, skunks and snakes are also common, and many of these smaller forms provide food for the abundant raptor population of the area. The larger carnivores like bears, wolves, and mountain lions are either locally extinct or rarely seen today but the smaller versions such as lynx, fox, bobcat, badger, weasel and, especially, coyote are still present in some numbers (Durrant 1952). Obviously, the project area provides an abundance of economic plant and animal resources that past cultures in the area could have exploited (e.g. Jennings _et al_. 1980). The most diverse of such resources are located in the better-watered and wooded areas of the Emery and Scattered Small Tracts, generally underlain by sandstone or basalt rather than shale. As will be shown in Chapters 4 and 5, these areas also yield the highest site densities of the project area, as one might suspect.

Chapter 3

Research Methods

Theoretical Approach and Sampling Strategy

The scope-of-work for this project called for survey of 100% of the Scattered Small Tracts, 10% of the Emery Tract and 20% of the Elmo Tract. This translates to a total of about 8,900 acres including 2,400 acres in the Scattered Small Tracts, 3,700 acres in the Emery Tract and 2,800 acres in the Elmo Tract. The scope left the choice of statistical techniques and sampling strategy up to the prospective offerors (Dept. of Interior-BLM 1983).

MAC proposed to apply both logistical regression and discriminant function analysis to data generated from a simple random sample (MAC 1983:31-42). The sampling universe consists of all BLM lands within each tract. Because the tracts are not contiguous, each was treated as a separate sample.

A sampling frame was constructed by numbering, consecutively, each sample unit in each tract. Our primary sample (PSU's) units were 80-acre blocks consisting of two 40-acre 1/4, 1/4 section units aligned east-west. The choice of alignment, east-west versus north-south, was made by a coin toss. Each full section had eight blocks, each 1/4 mi by 1/2 mile in dimensions. With each sample unit numbered a random numbers program, which draws one through N numbers without replacement, was run for each study area. In this way, each possible sample unit was placed in a random order. For Emery, the first 46 units drawn from a possible 451 units (10.2% or 3,680 acres) were surveyed and for the Elmo Tract 35 of a possible 154 units (22.7% or 2,800 acres) were surveyed.

The rationale for these choices are grounded in current archaeological sampling method and theory (cf. Mueller 1974; Kvamme 1980; Peebles 1981; Schroedl 1984). The choice of a simple random sample is in large part dictated by our choice of multivariate statistical methods, since such methods assume a simple random sample (Kish 1957). Also, it has been adequately demonstrated that simple random samples work better than do other schemes such as stratified random samples (Thomas 1975; Kvamme 1980; Plog et al. 1978; Schroedl 1984). This appears primarily to be because pre-defined strata are too gross to account for the influence of specialized microenvironments within broad strata. Another problem is that of dividing a limited number of sample units among several strata.

Economic considerations generally restrict sample size too much to allocate an adequate number of observations to each stratum.

The choice of 80 acre blocks was a compromise choice between larger quadrats and smaller transects or quadrats. Both quadrats and transects have advantages. Transects apparently yield a large percentage of sites in an area because they encounter more "boundary sites" (Plog et al. 1978:625), but quadrats are simpler to plot and locate in the field. The 80-acre units chosen for the Castle Valley Class II were selected because: 1) they are of a size that a small crew can cover in a typical day; 2) there is often at least one section or quarter section marker present in units of such a size; 3) with a sample size of 10% for Emery and 20% for Elmo these units gave us enough observations in each study tract for statistical analysis; and 4) 80-acre units are more economical to locate, access and survey than smaller units would be. Table 5 provides a listing of the sample draws for each tract should there ever be reason to expand the sample, and Tables 6 and 7 list the legal locations of the 81 surveyed sample units.

In summary, simple random samples of 80-acre sample units have been surveyed in the Castle Valley Class II lands. Ten percent of the area, or 46 PSU's, was inventoried in the Emery Tract and 20%, or 35 PSU's, was surveyed in the Elmo Tract. Completion of the Emery Tract was accomplished in three incremental stages: model development using Class I and Scattered Small Tracts data, model testing at the 5% sampling level, and model refinement using data from all 46 PSU's. A similar effort was planned for the Elmo Tract, but extremely low site density and similarly sparse Class I information forced us to conduct a standard one-stage sample survey both there and in the Scattered Small Tracts, with a conventional settlement pattern study conducted in addition to a tentative predictive model for the Elmo Tract.

Field Techniques

Field crew size ranged from three to six individuals, with the lower number most frequently employed; generally, two crews were dispatched to different units in the study tracts except during or just after especially inclement weather, when crews combined their efforts to minimize access problems. The procedure in the field was for each crew to first locate a

122 121 19 73 31 87 80 18 128 27 51 96 58 61 50 120 63 86
154 41 1 107 116 72 21 91 112 135 93 94 109 147 37 130 65 / 68
142 64 101 134 9 42 127 15 151 60 20 108 99 125 34 52 5 7 57
88 92 56 106 4 95 114 117 12 26 13 97 133 45 144 115 22 81
118 67 8 110 16 28 153 131 69 53 103 98 29 40 113 83 38 46
30 102 35 104 141 47 59 44 11 152 149 84 136 78 49 150 90 143
140 36 111 66 148 76 132 6 48 79 71 137 89 17 75 146 24 119
124 74 3 62 39 123 126 139 54 138 70 23 32 14 43 33 85 2 77
105 82 129 100 55 10 145 25

A.

2 29 20 67 327 111 290 421 45 348 132 258 42 124 234 313 227
22 269 78 451 137 274 / 41 201 300 63 25 40 8 314 337 336 251
445 173 259 43 273 206 125 293 427 385 5 441 / 110 355 129 369
429 127 317 357 33 281 245 194 346 181 203 371 270 391 306 112
241 120 65 414 133 114 268 265 340 338 36 406 157 442 81 433
126 382 349 319 215 161 71 311 3 109 288 21 386 99 394 107 72
252 146 365 411 398 145 283 408 284 248 213 214 360 374 94 400
183 261 232 380 446 139 79 182 378 308 301 323 289 35 128 113
54 188 174 150 431 154 228 59 254 118 123 332 135 266 31 198
184 11 401 37 276 49 368 149 102 331 74 275 225 453 407 262
244 309 185 430 452 390 405 420 191 333 202 292 354 291 377 387
233 70 216 418 345 299 341 1 413 246 231 393 247 115 402 10
138 366 312 222 285 131 165 207 328 172 170 253 324 26 77 60
303 166 30 66 257 168 439 28 199 106 287 189 108 53 264 15 158
434 229 160 279 95 440 242 424 57 193 444 195 310 438 6 316 90
164 219 9 412 351 171 156 436 352 318 96 97 92 295 58 238 249
98 85 224 204 305 344 218 335 122 356 353 322 186 68 373 217
196 372 347 350 370 130 175 24 447 397 44 448 416 307 263 51
13 297 143 364 152 197 230 298 302 286 69 423 47 208 141 116
88 176 410 80 187 282 376 210 12 239 142 395 178 100 271 358
362 212 435 326 343 87 46 83 255 101 140 162 383 367 278 415
179 75 4 235 73 250 396 117 50 16 236 84 180 19 56 52 381 220
223 256 450 76 403 18 277 315 153 205 192 330 39 379 32 209
342 449 48 93 91 399 280 163 177 34 272 14 389 384 419 260 443
237 211 375 151 437 329 325 422 104 27 7 105 147 119 134 425
359 144 38 240 409 243 226 428 103 388 339 136 363 304 61 17
64 55 417 169 190 296 148 82 89 167 62 200 159 392 121 320 361
221 267 432 334 23 155 321 86 404 426 294

B.

Table 5. Sample draw for A. Elmo Tract (N=154) and B. Emery Tract (N=451). The slash marks denote the sampling fraction chosen in each study area; the order of each draw begins at the upper left and proceeds across the rows, left to right.

Table 6
Legal Locations of Elmo Tract Sample Units (N=35 of 154)

DRAW	SAMPLE UNIT	QUAD	T	R	1/2 of 1/4 of Sec.
1	122	El/OR	16S	10E	N/SW/24
2	121	El	16S	10E	N/SE/23
3	19	OR	15S	11E	N/NE/34
4	73	OR	16S	11E	S/NW/8
5	31	OR	15S	11E	S/SW/33
6	87	OR	16S	11E	S/SW/8
7	80	El	16S	10E	N/SE/11
8	18	OR	15S	11E	N/NW/34
9	128	El/OR	16S	10E	S/SW/24
10	27	OR	15S	11E	N/SE/33
11	51	OR	16S	11E	N/SE/5
12	96	OR	16S	11E	S/NW/17
13	58	OR	16S	11E	S/SE/4
14	61	El	16S	10E	N/NE/9
15	50	OR	16S	11E	N/SW/5
16	120	El	16S	10E	N/SW/23
17	63	El	16S	10E	N/NE/10
18	86	El	16S	10E	SE/SW/11 & SW/SE/11
19	154	Cl/CF	17S	10E	S/SW/1
20	41	OR	16S	11E	N/NE/3
21	1	OR	15S	11E	N/NE/28
22	107	El	16S	10E	NE/NE/22 & NW/NW/23
23	116	El/OR	16S	10E	SE/NW/24 & SW/NE/24
24	72	El	16S	10E	S/NE/11
25	21	OR	15S	11E	S/NW/33
26	91	OR	16S	11E	N/NW/17
27	112	OR	16S	11E	N/NW/20
28	135	OR	16S	11E	N/NW/30
29	93	OR	16S	10E	S/NE/13
30	94	OR	16S	11E	S/NW/18
31	109	OR	16S	10E	N/NE/24
32	147	OR	16S	11E	N/NW/31
33	37	OR	16S	11E	N/NE/5
34	130	OR	16S	11E	S/SW/19
35	65	OR	16S	11E	NE/NE/8 & NW/NW/9

Key:

Cl = Cleveland　　El = Elmo
CF = Cow Flats　　OR = Olsen Reservoir

Table 7
Legal Locations of Emery Tract Sample Units (N=46 of 451)

DRAW	SAMPLE UNIT	QUAD	T	R	1/2 of 1/4 of Sec.
1	2	EE	22S	7E	S/NW/4
2	29	EE	22S	7E	S/SW/20
3	20	EE	22S	7E	S/NE/20
4	67	WF	23S	5E	N/NW/3
5	327	WF	23S	5E	N/SW/35
6	111	MB	23S	6E	N/NE/12
7	290	WF	23S	5E	S/SE/27
8	421	WS	24S	5E	S/SE/11
9	45	MB	22S	7E	N/SE/29
10	348	MB	23S	6E	S/SE/35
11	132	WF	23S	6E	N/SW/9
12	258	MB	23S	6E	N/NE/25
13	42	EE/MB	22S	7E	S/NE/28
14	124	WF	23S	5E	N/SW/10
15	234	WF	23S	6E	S/SE/19
16	313	MB	23S	6E	N/NW/35
17	227	MB	23S	6E	N/SW/24
18	22	EE	22S	7E	S/NE/21
19	269	MB	23S	6E	S/NE/27
20	78	WF	23S	6E	S/NE/6
21	451	WS	24S	6E	S/SE/18
22	137	WF	23S	5E	S/SW/11
23	274	WF	23S	5E	N/SE/27
24	41	EE/MB	22S	7E	S/NW/28
25	201	WF	23S	5E	S/NW/24
26	300	MB	23S	6E	S/SE/27
27	63	MB	22S	7E	S/SW/31
28	25	EE	22S	7E	N/SE/20
29	40	EE/MB	22S	7E	S/NE/29
30	8	EE	22S	7E	N/NE/9
31	314	MB	23S	6E	N/NE/35
32	337	WF	23S	5E	S/SW/34
33	336	MB	23S	6E	N/SE/35
34	251	WF	23S	6E	N/NW/29
35	445	WS	24S	6E	N/SE/18
36	173	MB	23S	6E	N/SE/14
37	259	WF	23S	5E	S/NE/27
38	43	MB	22S	7E	N/SE/30
39	273	MB	23S	6E	S/NE/25
40	206	WF	23S	6E	S/NE/20
41	125	WF	23S	5E	N/SE/10
42	293	WF	23S	5E	S/SW/25
43	427	WS	24S	6E	S/SE/8
44	385	WS	24S	5E	N/NE/12
45	5	EE	22S	7E	S/SW/4
46	441	WS	24S	6E	S/NE/17

Key: EE = Emery East; MB = Mesa Butte; WF = Walker Flat; WS = Willow Springs

corner of a given sample unit using natural and/or manmade landmarks depicted on the topographic maps. This was a fairly easy task in the Elmo and Scattered Small Tracts where access was good and most section and quarter-section corner caps were both undisturbed and visible. In those two tracts, most caps had been emplaced relatively recently, such as 1969. In the Emery Tract, certain units were quite remote with few and poor roads characteristic of some locales. On Mesa Butte and in the badlands east of the Coal Cliffs, for instance, crews sometimes spent over an hour by car and on foot traveling to and returning from some sample units. Nonetheless, unit corners were usually easy to estimate in those instances when section caps could not be located, since the terrain in the Emery Tract is generally dissected with numerous landmarks to correlate with the topographic maps. Corner caps in the Emery Tract ranged widely in age, from as old as 1904 at the base of the Coal Cliffs to 1978 in the Muddy Creek-lower Ivie Creek area.

Spacing between crew members was maintained at 15 m, with straight-line transects oriented east-west most commonly walked. In very steep terrain, however, transects oriented parallel to ground contours (e.g., on canyon slopes, ridge crests and drainages) were employed (Figure 11). Some barren, extremely steep slopes (greater than 35°) were not covered unless visual inspection suggested the possibility of rockshelters, rock art or the like. After each sample unit was completed, a sample unit record form was completed that summarized the environmental conditions there as well as listing the sites and isolated finds present. This form was nothing more than a modified version of the second page (Environmental Data) of Part A of the IMACS site form.

Once cultural resources were located the first step was to identify the resource as a site or isolated find (IF). The definition of cultural resources provided by the Bureau of Land Management (1984:1) served as the basis for our definition.

> BLM, in Utah, defines a site as a discrete locus of human activity presumed to be interpretable. Isolated finds are not considered sites and Cultural Resource Professional (CRP) discretion should be employed in plotting, describing, and interpreting such values.

For loci which meet these criteria, site type categories have been defined for use in description and analysis (see Chapter 4). The

FIGURE 11

Conventional survey tactics were modified to cover heavily dissected areas such as this. The view is to the west-northwest in unit 300 of the Emery Tract, from the southwest edge of Mesa Butte. Roll MA-16-84, neg. #11.

Site recording in progress at 42EM1994 on Molen Reef, in unit 45 of the Emery Tract (view to the west-southwest). Note pin flags at artifact concentration. Roll MA-23-84, neg. #21.

FIGURE 12

distinction between isolated finds and sites required pre-field definition. Simple flake or sherd density counts alone cannot be used because they do not allow for interpretation of the depositional context of the locality. Our approach to minimum site definition combined artifact or feature presence with an assessment of the potential for buried cultural material and an assessment of the known cultural surroundings. A few flakes found in rodent back dirt in a good depositional context would likely be classified as a site, while a few flakes found on bedrock would not. Likewise, a scatter of a few sherds found in an area of high site density might be considered an isolate, but a similar scatter found where such artifacts are rare might be considered a site. As the guidelines suggest, minimum site definition required professional judgement.

Site recording duties included filling out an IMACS site form, drawing a site sketch map, taking a photograph of the site area and of non-portable artifacts, plotting the site location on the topographic map, and (in some cases) collecting diagnostic artifacts (Figure 12). Prior to any limited artifact collection, all tools and artifact concentrations were plotted on the sketch map relative to the site datum, which consisted of a length of metal rebar or several pin flags to which a metal tag was affixed bearing the temporary site number. After mapping, diagnostic tools were collected if present. In certain areas, such as the heavily wooded Molen Reef and on low mesas below the Saleratus Benches in the Emery Tract, artifact scatters stretch over huge areas rendering adequate recording a difficult process. Occasionally, topographic features such as drainages, ledges or hillslopes were used to divide these huge areas into smaller "sites". Admittedly, the process was arbitrary at times and has implications for settlement studies, but it was our opinion that as long as all pertinent information was recorded and mapped, it made little difference how many site forms were filled out to do it.

Where the depositional character of site sediments was not obvious, small shovel or trowel probes were excavated. These probes gave an indication of the potential for buried cultural material as well as soil characteristics, but should not be considered test excavations in the formal sense. They were useful in confirming negative assessments of site

significance, but were not intended to be definitive indicators of National Register eligibility. Rather, each site's potential eligibility for the NRHP was assessed using a broad range of site characteristics such as artifact density and diversity, presence of features, integrity of cultural fill, uniqueness of site material, and potential to yield information to our understanding of local and regional prehistory beyond that already recorded. For the inherently insignificant isolated finds (IFs), an IF log sheet was filled out summarizing artifacts present and the local setting. Each IF was plotted on the appropriate topographic map, but no sketch map was drawn nor photos taken. Diagnostic isolates were collected.

Laboratory and Report Methods

In addition to locational modelling, laboratory analysis fulfills a number of needs and reflects the variety of data classes available to study. Data analysis serves to elucidate the following:

(a) temporal placement of sites
(b) function(s) of sites
(c) cultural affiliation(s) of sites
(d) temporal placement of artifacts (including both ceramics and lithics)
(e) function(s) of artifacts (ceramics, lithics, ground stone, and bone, if present)
(f) cultural affiliation(s) of artifacts (ceramics, lithics)
(g) function(s) of features, e.g., structures and hearths

Site functional analysis was based on a variety of characteristics, with no one factor weighted over the others as a general rule; only with rockshelters and quarries were site types assigned based on a single characteristic. For other site types such factors as site size, number and diversity of tools, approximate tool-to-debitage ratio, and presence/absence of ceramics, ground stone and features were assessed. Locational data were not employed in the site functional analysis. See Chapter 4 for detailed definitions of individual site types.

Lithic analysis was techno-functional in nature. Because of the limitations placed on field collections by the BLM, certain types of information required field recording and brief analysis. A detailed technological analysis of lithic reduction evidence was not feasible

because it would require laboratory inspection of large, systematic, representative collections. However, field observation permitted more generalized statements as to manufacturing activities (e.g., primary core reduction vs. tool finishing). Lithic material types present on site also were noted in an effort to associate them with known source localities, and exotic materials occasionally were collected (i.e., obsidian) for later identification in order to demonstrate trade connections or interaction between areas.

Lithic tools have been classified into morphological categories from which functional implications can be drawn. Functional types represent a major variable employed in site diversity indexing (above). Again, detailed analysis such as edge-angle study was not possible because of collection limitations. Projectile points were collected, both for management and analytical reasons: they are the most vulnerable of all lithic artifacts to illicit collection by amateurs and vandals, and are critical in assigning sites to chronological periods. They are, in some cases, also useful as indicators of cultural affiliation. This is particularly true for non-ceramic sites for which no other temporal or cultural-specific indicators occur on the surface. In the case of ceramic sites, projectile points provide important corroborative temporal data. Edge wear studies were completed on the collected points in the present study to define possible functions other than as weapon tips.

Ceramics were employed primarily as indicators of cultural affiliation and age. As with most lithic classes, detailed functional analysis was precluded by collection limitations. Sherds were retrieved from sites only in cases where positive identifications could not be made in the field, and then only small collections were made. Apparent trade wares also were to be collected for later identification in an effort to document prehistoric cultural contacts, but very few such artifacts were found. All collected artifacts will be curated with Southern Utah State College in Cedar City; Appendix 7 provides a list of these items.

Collections of ground stone were not made. Ground stone is common throughout much of the study area, however, and notes on attributes of ground stone artifacts observed on the surface were recorded systematically on the IMACS site forms. Data so collected has been integrated into site functional interpretation. Faunal remains were

were observed very infrequently, e.g., in eroded hearth contexts. No diagnostic bone was seen or collected, however.

In summary, analysis of sites has focused upon age, function and cultural affiliation. Age determination was based upon ceramics and diagnostic lithic artifacts (projectile points). Cultural affiliation was interpreted primarily through ceramics or, where feasible, projectile points. Functional analysis involved several lines of evidence including site size and artifact density, hearth features and structural remains, lithics, ceramics, ground stone and faunal materials. Artifact diversity indexing was not applied due to the absence of representative collections, but a general measure of diversity (i.e., number of tool classes present) was included in the analysis. Artifact analyses were necessarily limited in scope, and emphasized classification into known types of ceramics (e.g., R. Madsen 1977) or projectile points (Holmer 1978; Holmer and Weder 1980). A functional edge wear analysis on projectile points also has been completed, recognizing the post-discard damage that can be inflicted on artifacts exposed at the surface and collected by survey crews (e.g., Knudson 1979).

In other lab duties site forms were proofread and typed, site sketch maps were inked, and photographs developed and printed. Orthophotoquad and topographic maps were prepared depicting sample units, project area, site and IF locations; collected bottles and one shell were sketched for illustration in the report, and all other artifacts (chipped stone, ceramics) photographed. Drafting of line drawings, maps and artifact sketches was accomplished by Anne McKibbin, who also provided shell and bottle identifications, Sally J. Metcalf developed and printed photographs, and typed the manuscript. Various other lab duties like artifact washing and cataloguing, and filling out legal locations on site forms, were performed by Julie Medsker under the direction of Kevin Black. The specifics of model development and testing are presented in Chapter 5.

Problems

Field work proceeded smoothly for both the Elmo and Scattered Small Tracts; access problems were minimal and weather conditions were favorable. Survey in the Emery Tract turned out to be somewhat of an

adventure at times, however. In particular, weather problems were common with late August and early September, 1984 characterized by rainy, spring-like cold fronts rather than the "scattered" thunderstorms expected in late summer. In fact, conditions deteriorated so much that most roads in the Emery Tract became impassable by August 19 (many traverse Mancos Shale badlands that turn to "gumbo" when wet), and forced us to take an unscheduled break in the survey. Even when dry, some access routes were excruciatingly slow and long; because sample units were not numerous enough in such areas to warrant moving our field camp, travel time to these areas cut into survey time to a limited degree. Thankfully, harassment by swarms of insects was limited to a couple weeks of dealing with small flies in the Emery Tract, and was no problem at all in the Elmo and Scattered Small Tracts. One severe windstorm did damage our field camp in September, 1984, however.

Another problem, mentioned above, was that some wooded portions of the Emery Tract yielded dense site zones where artifact scatters were nearly continuous and site boundaries accordingly difficult to define. Our solution took two options: "splitting" the site zone into discrete areas based on breaks in local topography, and "lumping" the scatter into one big site when no such topographic features existed and no distinct break between adjoining artifact concentrations could be seen. Thus, our definition of a site in the Emery Tract was a contiguous zone of artifacts and/or features bounded by natural topographic landforms and/or a break in the presence of artifacts of at least 50-100 m. Overall we probably lumped more than we split, a decision made to expedite the recording process in the face of high site densities and the aforementioned weather problems.

One minor problem was that not all previously recorded sites in the project area were in a single file location, in part due to the fact that the Emery Tract lies in two separate BLM districts. In reality, however, the present system is a significant improvement over the situation encountered by Hauck (1979a:104-110) prior to implementation of the IMACS methods now available for most of the state. Actually, considering the large area involved and the substantial volume of previous work conducted especially around the Emery Tract, the file search effort required for the present project was not unreasonable.

One other problem already mentioned is the lack of data available for the Elmo Tract, hindering development of a statistically valid predictive model for that area. As will be discussed in more detailed below, possible solutions include surveying a large sampling fraction supplemented by data from sites recorded in far-outlying areas, or relying on non-statistical settlement pattern studies to characterize prehistoric site location preferences.

Finally, the re-recording of known sites in the Emery Tract presented an occasional challenge. This was especially true for sites recorded more than 15 years ago, such as Interstate 70 survey sites 42EM151-163 (Table 2) recorded in 1962 with no accompanying report. One of the nine previously recorded sites in surveyed sample units, 42EM152, is a rectangular arrangement of wooden poles and basalt boulders on a bench above an intermittent tributary of Ivie Creek. But despite a concerted search in sample unit #234 where the site was estimated to be, no such remains could be found. The site may be located farther upstream (southwest); this problem illustrates a common circumstance with sites recorded long ago in this area, i.e. the vague locational descriptions employed prior to publication of 7.5' color topographic maps in the late 1960s.

A second common occurrence was that sites originally described as small artifact concentrations turned out to be much larger archaeological manifestations. Two localities stand out in this regard: the site cluster 42SV415-440 on a low dissected mesa between the Saleratus Benches and Walker Flat, and similar site cluster 42SV474-480 near the head of Willow Springs Wash (see Helm 1973, 1974; Berry 1974). Two other known clusters in or near the project area but not encountered in the present survey--42EM181 through 223 on the west mesa rim of Quitchupah Creek (Berge 1973, 1974) and the huge Trough Hollow site zone (e.g. Berge 1973; Copeland and Webster 1983)--are likely quite comparable to the two clusters cited above. Where we re-surveyed in units 125, 137 and 421 of the Emery Tract, however, extensive zones of artifacts and features were encountered with few of the breaks in material culture implied by the descriptions on the site forms.

The aforementioned area on Molen Reef, where artifact concentrations were connected by lighter scatters over huge parcels of land, was

dissimilar only in the general dearth of features there. In the case of the two Sevier County site clusters, rather than reassigning site numbers to conform to field observations, we kept the original number of sites but expanded the site boundaries out to topographic features separating the nearly continuous artifact scatters there. Hopefully, this will avoid confusion in the future, but those two situations were handled in a different way from newly discovered site zones like that on the crest of Molen Reef (see above discussion of lumping vs. splitting site zones). In the following chapter, the results of survey in the three study tracts are presented as well as a summary of site-environment correlations, a discussion of site types in the project area, tabular lists of site significance, and artifact descriptions.

CHAPTER 4

Results

Site Types and the Scattered Small Tracts

Twenty-five parcels of land totalling 2,400 acres (971 ha) were surveyed by MAC between October 24 and November 4, 1983. Called the Scattered Small Tracts (Figure 3), these parcels range in size from 40 to 320 acres (16-130 ha) and provide broad coverage of a variety of terrain between the towns of Elmo and Emery. Inventory of these lands resulted in the discovery of 26 sites, including one paleontological resource and one of Historic period age, and 30 IFs. Table 8 summarizes the survey results; it is the revised version (with permanent site numbers) of Table 1 sent to the BLM with a letter report dated November 9, 1983. Tables 9 and 10 provide information concerning site types and environmental variables for the 24 aboriginal sites recorded. See Appendices 2-2 and 2-5 for more detailed information on each site and IF.

The site type breakdown presented in Table 10 deserves further elaboration here. In Chapter 5 a predictive model for the Emery Tract is developed using both discriminant analysis and logistic regression. The first step in developing such a model is to define the groups, or dependent variable. In this study, the pre-defined groups will be categorized by the number and types of archaeological sites present. It is important in a study like this--where relationships among resource locations and activity locations are being studied--that the means of defining activity sites are independent of their location. One such method is by defining site types based in part on a tool diversity index (Shannon 1948; Zar 1974; Teachman 1980). Recent examples of tool diversity studies in archaeology include Camilli (1975), Wood (1978), Reher (1979) and Black *et al.* (1984). However, as noted in the previous chapter, the lack of statistically representative artifact collections precludes computations of such an index for the sites found during the present project. An approximate diversity measure--the total number of tool classes present--was used in the site typology, but *in combination* with other factors including: 1) site size; 2) total number of tools present; 3) presence/absence of ceramics; 4) presence/absence of ground stone; 5) presence/absence of features; 6) tool-to-debitage ratio

Table 8
Survey Results in the Scattered Small Tracts

SST #	Legal Description	Parcel Size	Sites/IFs Recorded	CRM Clearance
1	SW/SE Sec 19, T16S R10E	40	None	Yes
2	SE/NE Sec 25, T16S R9E	40	IF 5	Yes
3	NW/NW/S2/NW Sec 1, T17S R9E	120	IF 4	Yes
4	N2/NW Sec 1, T18S R8E	80	None	Yes
5	NW/SE Sec 6, T18S R9E	40	IF C	Yes
6	SE/SW Sec 3, T18S R9E	40	None	Yes
7	E2/SE Sec 12, T18S R8E N2/SW, SE/SW, SW/SE Sec 7 N2/NE Sec 18, T18S R9E	320	IFs A & B	Yes
8	NE/NE Sec 7, T18S R9E	40	None	Yes
9	E2/SW, SE Sec 9, T18S, R9E	240	IF 3	Yes
10	E2/NE Sec 10, T18S, R9E	80	None	Yes
11	SE/NW, W2/SE Sec 17 NW/NW, S2/NW, W2/NE Sec 20, T18S R9E	320	IFs 1 & 2	Yes
12	SE/SE Sec 23 NE/NE Sec 26, T18S, R8E	80	IF I	Yes
13	NE/NW, NE, NW/SE Sec 35, T18S, R8E	240	IFs D-F EM2074-76	Yes
14	SE/SE Sec 3, T18S R8E	40	IFs J & K, EM2056	Yes
15	SE/SE Sec 11 SW/SW Sec 12, T19S R8E	80	IFs G-H, EM2077	Yes
16	NW/NW Sec 17, T19S R8E	40	None	Yes
17	E2/SW Sec 17, T19S R8E	80	IFs 6-11	Yes
18	SE/NE Sec 4, T20S R7E	40	EM2057	Yes
19	SW/NE, NW/SE Sec 12, T20S R7E	80	EM2063	Yes
20	NE/NW Sec 18, T20E R7E	40	IFs L-M, EM2058- 62, EM2066	No
21	NW/NW Sec 27, T20S R7E	40	IF 16	Yes
22	SW/NE, NW/SE Sec 27, T20S R7E	80	IF 15	Yes
23	NE/NW, N2/NE Sec 27, T21S R6E	120	IFs 12-14,EM2078- 80, EM2068-73	No
24	NW/SW Sec 31, T21S T7E	40	IF 17, EM2067	Yes
25	SW/SW Sec 4, T22S R6E	40	EM2064-65	No

Table 9
Locational Data for Sites in the Scattered Small Tracts

Perm Site #	SST Parcel No.	Elevation (feet)	Vegetation*	Landform	Nearest Perm Water(m)	Site Type**
42EM2056	14	5,640	d.s./greasewood	low ridge	1,000	quarry
2057	18	6,080	d.s./shadscale	valley edge (riser)	2,600	quarry
2058	20	6,220	pinyon-juniper	bench	1,050	chipping-LD
2059	20	6,240	pinyon-juniper	bench	1,180	chipping-LD
2060	20	6,260	pinyon-juniper	bench	1,000	short-term camp
2061	20	6,200	pinyon-juniper	bench	830	chipping-LD
2062	20	6,195	pinyon-juniper	terrace	900	short-term camp
2063	19	5,880	d.s./shadscale	mesa top	1,800	quarry
2067	24	6,320	d.s./shadscale	ridge	1,000	quarry
2064	25	6,320	d.s./dry meadow	valley ridge	0	Historic habitation
2065	25	6,390	juniper/shadscale	toe of mesa slope	5,200	rockshelter
2066	20	6,360	p-j/sagebrush	butte top	900	habitation
2068	23	6,500	pinyon-juniper	bench	700	habitation & quarry
2069	23	6,620	pinyon-juniper	mesa rim	750	quarry
2070	23	6,420	pinyon-juniper	toe of mesa slope	1,000	short-term camp
2071	23	6,370	pinyon-juniper	valley slope	1,100	short-term camp
2073	23	6,420	pinyon-juniper	valley edge	1,000	short-term camp
2072	23	6,500	pinyon-juniper	bench	1,100	short-term camp
2074	13	5,600	d.s.-shadscale	valley	950	chipping-LD
2075	13	5,600	d.s.-shadscale	toe of mesa slope	950	chipping-LD
2076	13	5,640	d.s.-shadscale	toe of mesa slope	1,200	quarry
2077	15	5,560	d.s.-shadscale	ridge	200	quarry
2078	23	6,620	pinyon-juniper	bench	1,000	habitation
2079	23	6,630	pinyon-juniper	bench	1,150	short-term camp
2080	23	6,400	d.s./dry meadow	valley edge	1,100	chipping-LD

* d.s.= desert shrub
** LD = low diversity

Table 10
Correlation Matrix: Environmental Variables vs Site Types in the SSTs

	Vegetation				Elevation(ft)				Landform								Horiz Dist to Nearest Perm Water					
	PJ	DS	BS	RP	5-55	55-6	6-65	65-7	BT	RT	MI	MR	HS	TR	BN	VE	A	B	C	D	E	F
Habitation	3	0	0	0	0	0	2	1	1	0	0	0	0	0	2	0	0	0	2	1	0	0
S-T Camp	7	0	0	0	0	0	6	1	0	0	0	0	0	1	3	3	0	0	1	6	0	0
Chipping-LD	4	2	0	0	0	2	4	0	0	0	0	0	0	0	3	3	0	0	3	3	0	0
Quarry	1	7	0	0	0	4	3	1	0	3	1	1	0	0	1	2	0	1	2	3	1	1
Rockshelter	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Historic	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Totals*	16	10	0	0	0	6	17	3	1	3	1	1	0	1	9	10	1	1	8	13	1	2

* = One site, 42EM2068, is included in both habitation and quarry categories

Key:

S-T = Short-Term
LD = Low Diversity
PJ = Pinyon-Juniper
DS = Desert Shrub
BS = Big Sagebrush
RP = Riparian
5-55 = 5000-5499
55-6 = 5500-5999
6-65 = 6000-6499
65-7 = 6500-7000
BT = Butte Top
RT = Ridge Top
MI = Mesa Interior
MR = Mesa Rim
HS = Hillslope
TR = Terrace
BN = Bench
VE = Valley Edge
A = 0-99m
B = 100-499m
C = 500-999m
D = 1-1.49 km
E = 1.5-1.99km
F = 2km or more

(approximated, not computed); and 7) type(s) of features present, if any. Thus, the Castle Valley site typology is a "polythetic" scheme as defined by Toll (1977:45-49) and Williams et al. (1973), in which a combination of site attributes--or absence of these attributes--is necessary to assign a site to a given site type category. This typology is similar to, but modified from, those of Peebles et al. (1983a, 1983b) and Black et al. (1984:118-121).

Four major site classes are defined at Castle Valley: multiple activity (prehistoric), limited activity (prehistoric), paleontological and historic. Multiple activity sites include habitations, medium diversity chipping stations and short-term camps. Limited activity sites include quarries, vegetal processing sites and low diversity chipping stations. Rockshelters are morphological site types which can be either multiple or limited activity sites. Rock art, an eighth site type, was not observed in the survey tracts other than at habitation site Snake Rock Village (Aikens 1967:Figure 2). The historic sites include habitations, short-term camps, trash scatters and fence lines. Definitions of these types follow; see Appendix 2 for further details.

Multiple Activity Sites (Prehistoric):

Structure ruins (rubble, pithouse depressions, etc.), hearths, middens, fire-cracked rock scatters, charcoal or charcoal stains, chipped stone and ground stone tools, pottery, and unmodified burned or butchered bone may be present. These remains may represent plant and animal processing loci as well as stone tool manufacture and repair areas, in occupation zones where the length of stay varied widely but was at least overnight. Perhaps most such sites were visited more than once, accounting for the huge size exhibited in some cases.

Habitation: A site representing intensive, long-term (at least seasonal) and possibly repeated occupation. In the project area habitations are larger than 4,600 m^2--they average 149,757 m^2--as well as having one or more features and at least three tool classes present. All but one of these sites has ceramic and/or ground stone artifacts, and most have ten or more tools. Ruins of dwelling structures are present at a minimum of four of the habitations, and rockshelters are found as minor

elements at two others. Two habitations are located at tool stone outcrops and include quarry components. Seventeen habitations are present in the Emery and Scattered Small Tracts, with three of those in the latter study area. Snake Rock Village, site 42SV5, is an example of a relatively small but intensively occupied habitation in the Emery Tract (Gunnerson 1957a; Aikens 1967; this report).

Inspection of the data table for this site type in Appendix 2 suggests that two subtypes may be present in the project area: year-round habitations characterized by an abundance of tools and tool classes; and seasonal habitations having a more limited assemblage of tools in association with numerous features. Snake Rock Village and 42EM2068 are examples of probable year-round habitations, while sites 42SV2034, 42EM2034 and 42EM2051 may represent shorter but still intensive occupation periods. The latter sites differ from similar short-term camps in having a greater total number of features, as well as more non-hearth features such as pithouse depressions and middens. The larger habitations like 42EM2044 and 42EM2048 almost certainly include multiple components.

Short-Term Camp: A site type similar to a habitation but on a smaller, less complex/intense scale. In the three study tracts this type ranges in size from 1 m^2 to 56,549 m^2 and averages 7,034 m^2. This site category includes simple isolated hearths with no associated artifacts as well as more typical camps having a few chipped stone tools, pottery and/or ground stone. Features are common, but never in great number and never include dwelling ruins. All camps have at least one example of one or more of the following three characteristics: pottery, ground stone and features. Two camps are located at tool stone outcrops and, thus, also include quarrying loci. Thirty-nine camps are identified in the project area, of which seven are in the Scattered Small Tracts. Short-term camps are often located at rockshelters (e.g., Sudden Shelter; Jennings et al. 1980), but these sites are included in a separate morphological type defined below as "rockshelters".

As with habitations, two possible subtypes within the short-term camp category can be delimited: "medium diversity" camps with a variety of chipped stone tool classes, ceramics and/or ground stone present (e.g., 42EM2060 and 42SV439); and "low diversity" camps with one or more features

but few associated tools or tool classes. The latter are quite common in the project area, and may not be "multiple activity" sites at all. They have been so classified here because of the common practice of categorizing any site with a hearth and/or pottery in the absence of dwelling structures as a camp. However, in the future it may be necessary--and fruitful for predictive model refinement--to distinguish between "multiple activity" and "limited activity" camps, or to include the latter in some other existing category such as the "processing" type defined below. Excavation of such sites is needed to provide further guidance on this issue.

Medium Diversity Chipping Station: A site lacking features, pottery and ground stone artifacts, but having a moderately high tool-to-debitage ratio with at least three tool classes represented. In the Castle Valley project area, this type ranges up to 44,000 m^2 and averages 13,879 m^2 in size. Nine such sites are in the project area--all in the Emery Tract--and one occurs at a small tool stone outcrop that was quarried to a limited extent (42SV2048). Functionally, this site type is probably similar to processing sites (see below) with the addition of more intensive stone tool manufacturing/repairing activity represented in the abundance of debitage present. Sites elsewhere in the region of this type have been called "lithic scatters", "open lithic sites" or just "chipping sites" in the past, but we believe moderately diverse behavior patterns are masked in such a classification. While we recognize that the variety and nature of site activities is undefined in our "chipping-MD" category, at least these sites are separated from more typical chipping sites where tool manufacture and/or core reduction was nearly the only activity performed.

Rockshelter: A morphological site type which includes caves, alcoves, shelters under isolated boulders and bases of cliffs directionally shielded from the elements. Evidence for multiple activities, especially similar to the "medium diversity" short-term camp site type found in open settings, is very common in rockshelters but more limited activity shelters and rock art with no associated material culture are occasionally encountered (neither of the latter two situations is represented among our

recorded sites, however). Seven sites in the project area, including one in the Scattered Small Tracts (42EM2065; Miller n.d.) and six in the Emery Tract, have rockshelters as a prominent feature; two such sites are huge habitation zones surrounding the shelter loci. Five of the seven rockshelter sites have ceramic sherds and only one (42EM669) lacks features visible at the surface (the latter site's hearth recorded in 1976 is actually a small shale lens or similar natural deposit). This type averages 78,054 m^2, but only 22,341 m^2 in size if habitation site 42EM2006 is excluded.

Limited Activity Sites (Prehistoric):

These sites are characterized by homogeneous artifact assemblages. Fewer classes of tools are represented and features are rare.

Processing: These sites are similar to "tool kits" (e.g., Black *et al*. 1982:55-59), defined as "areas of high tool density, low tool diversity, and low debitage density [i.e., very high tool-to-debitage ratio] in a relatively confined space" (ibid.:55). Two subtypes are present: those sites characterized by ground stone concentrations, and those sites having chipped stone tool concentrations. Five processing sites have been identified in the project area (none in the SSTs), including three vegetal processing loci (with ground stone) and two with chipped stone tools. Two of the former also exhibit burned stone concentrations which may represent roasting pits or similar features. As defined above, these sites are generally quite small; the five project examples average 733 m^2 in size and do not exceed 3,000 m^2. Previously recorded site 42EM770 is an example of a vegetal processing site in the Emery Tract, while 42EM1981 in the Elmo Tract has a collection of bifaces and modified flakes suggesting faunal processing/butchering as one possible function.

Quarry: Raw lithic materials are being quarried at their natural outcrop or exposure. Chalcedony, chert and quartzite were quarried in the area, particularly from the pediment gravels and cobbles washed from the Wasatch Plateau and deposited in Castle Valley where they are preserved on elevated mesas, knolls and terraces. This situation is prevalent in the Scattered Small Tracts, where eight quarries have been recorded, but such

pediment gravel deposits are either absent or of very low quality in the Elmo Tract. Fifteen quarries have been recorded in the Emery Tract, and their distribution contrasts with those in the Scattered Small Tracts. That is, the pediment gravels are more heavily eroded in the former, presenting a "patchy" distribution. Thus, three distinct outcrop zones have been identified for this tool stone source in the Emery Tract: 1) as sparse lag gravels on high sandstone mesas and cuestas like Molen Reef; 2) as moderately dense lag gravels on shale badlands in the lower Ivie Creek-Muddy Creek valley area below 6,100 ft; and 3) on the upper margins of Ivie Creek Bench and vicinity, where erosion has concentrated the larger tool stone nodules on side slopes and benches while the mesa top itself exhibits a cap of smaller, unknappable pebble-sized gravels.

That sites occur on moderately-sloping hillsides might come as a surprise to some; such slopes are sometimes ignored in archaeological surveys due to the preconceived notion that they are unsuitable for occupation. Other work has shown, however, that in areas where tool stone outcrops occur, quarries and other limited activity site types are not uncommon on side slopes where overview quality is high (e.g. Black et al. 1982:129, 1984:123-124). In the Emery Tract, wooded slopes with gradients less than 30° should be considered potential site locations deserving of intensive survey (Figure 10).

Because the size of quarry sites largely is a function of the size of the outcrop being exploited, a very wide range in areal extent characterizes the type: from 94 m^2 to more than 350,000 m^2 in size within the Emery Tract and Scattered Small Tracts, averaging 43,574 m^2. Of the 23 quarries, two co-occur with habitations, two with short-term camps, one with a medium-diversity chipping station and three are minor components at low diversity chipping stations. Tools are rare at most quarries--unmodified bifacial blanks/preforms and hammerstones are most often encountered--and features other than procurement pits are likewise uncommon (the depressions at quarry-habitation site 42EM2051 are rather large for procurement pits, and may be pithouse ruins instead).

Low Diversity Chipping Station: This site type is characterized by the presence of dispersed or concentrated chipped stone detritus and sparse tools, indicative of stone tool manufacture and/or repair as the

primary function. Features, ground stone and ceramic artifacts are always absent, and no more than two tool classes are generally represented (as at quarry sites, unmodified bifaces and hammerstones are most common). They differ from medium diversity chipping stations in having fewer tool classes present and a lower tool-to-debitage ratio; they contrast with processing sites especially in the latter factor where flintknapping predominates over tool use for other purposes. Two subtypes are included in this classification: primary chipping stations where core reduction activities are dominant, and secondary chipping stations where tool finishing/repair activities predominate. By definition, all quarry sites include primary chipping station loci, but not all primary chipping stations occur at quarry sites since core reduction can take place far from tool stone outcrops. The 45 sites of this type include two in the Elmo Tract, six in the Scattered Small Tracts and 37 in the Emery Tract--three of the latter also contain quarry loci. They range widely in size from 79 m^2 to 56,077 m^2 (the larger examples indicative of repeated visits to site areas), and average 3,747 m^2.

Rock Art: Petroglyphs, pictographs or a combination of both are present in one or more panels (Schaafsma 1971). This site type occasionally occurs at rockshelters or other site types, but perhaps more commonly is isolated with few associated artifacts. Rock art is relatively common in central Utah (e.g., Berge 1983:13-14), and three local sites are on the National or State Registers (Holmer 1982:Table 3.1.2). The Rochester Wash panel (Gunnerson 1969:Fig. 25B) is a particularly fine example of petroglyphs in the Castle Valley area. Strangely only one site in surveyed sample units--Snake Rock Village in the Emery Tract (Aikens 1967)--exhibits a rock art panel of any kind. Both the low overall density of rock art as a discrete site type and the absence of such sites in our sample suggest such resources would be ignored in the typical predictive model.

Paleontological Sites:

Fossils and fossil imprints of extinct plants and animals are known to occur in this area of Utah (e.g., 42EM714 between Walker Flat and Quitchupah Creek) but, apart from the Cleveland-Lloyd dinosaur quarry south of the Elmo Tract, little paleontological research has been carried

out and published data are few (Eaton and Kirkland 1985; Katich 1956). Only one paleontological site has been recorded, i.e., marine invertebrates within the Scattered Small Tracts from the Blue Gate Shale member of the Mancos formation. However, our survey was not intended to locate paleontological resources, and no "clearance" for management purposes should be inferred from the lack of such sites in our sample. The Castle Valley region is relatively untapped, with suggestions of highly significant fossils coming from recent investigations (e.g., early mammals; Eaton and Kirkland 1985). Lindsay and Rauch (1982:Figure 2.2.1) illustrate the distribution of known fossiliferous formations in Castle Valley, but we disagree with their evaluation that the Blue Gate Shale lacks significant fossils since so little research has been done (Holmer 1982:34).

Historic Sites:

Late 19th and 20th century structures, features and trash of Euro-American derivation was encountered with some regularity in the project area, with historic IFs far outnumbering Historic period sites. No aboriginal sites or IFs with artifacts diagnostic of the Historic period have been found, however. Almost all of the fourteen historic sites relate to the ranching industry, with temporary camps and trash scatters most common. Two historic sites have been recorded in the Elmo Tract, two in the Scattered Small Tracts and ten in the Emery Tract; six of the 14 sites co-occur with prehistoric aboriginal sites. Four historic site types are present, and are defined as follows.

<u>Habitation</u>: This site type includes loci of year-round occupation characterized by dwelling structures, outbuildings and diverse trash. Only one habitation, 42EM2064 on the outskirts of the town of Emery in the Scattered Small Tracts, has been recorded. That site measures 19,085 m^2 in area and includes abundant trash, a house and barn, at least two other structure ruins and a small fruit orchard.

<u>Camp</u>: The type has evidence of short-term occupation in the form of trash dumps, hearths, temporary structures and/or cairns. Isolated features such as those described sometimes occur (e.g., site 42EM152), but more often a trash scatter is associated. This site type appears to be largely related to the ranching industry, such as sheepherding activities, as suggested by fence lines, cairns and herbivore dung concentrations

which commonly occur on or nearby these sites. Eight historic camps have been recorded, including two in the Elmo Tract, one in the Scattered Small Tracts and five in the Emery Tract. They range in size between 7 m^2 and 29,452 m^2, with an average of 5,312 m^2.

Trash Scatters: This site type is characterized by sparsely distributed artifacts or concentrated trash dumps with no associated features. Thus, they are similar to camps and may represent similar activities, especially relating to the ranching industry. Numerous trash dumps were encountered in the Scattered Small Tracts, but most included recent trash and were recorded as IFs. The three trash scatters recorded as sites, all in the Emery Tract, range narrowly in size between 9 and 16 m^2, with an average of 11.7 m^2.

Fence: This type includes hand-made, wooden fence lines without associated artifacts other than wire and/or nails; more recent barbed wire fences were not recorded. Two fence lines were recorded, both in the Emery Tract, and both were constructed as barriers to confine stock animals onto, or away from, a low mesa. In addition a rock wall, which probably served a similar barrier function, was observed outside any surveyed unit on the west side of Mesa Butte.

Returning to the discussion of results from the individual study tracts Tables 9 and 10 show that, taken as a whole, sites in the Scattered Small Tracts are located in two major settings: on wooded benches and adjacent valley edge slopes along the east margin of the Wasatch Plateau, and in the interior portions of Castle Valley within the shadscale plant community. These two areas are usually at elevations of 6,000-6,500 ft and are located a kilometer or more from permanent water. Multiple activity sites are exclusively within the pinyon-juniper zone, albeit often in more sparsely wooded ecotone settings; limited activity sites are found in more diverse environmental situations. Tool stone procurement is well-represented in sites on low mesas and ridges capped with pediment gravels containing knappable material types, especially cherts and chalcedonies. Interestingly, no quarries were located in the Elmo Tract, suggesting that such sites are most prevalent in the central and southern portions of the Castle Valley where the distribution of pediment gravels is apparently concentrated.

Fifteen of the 26 sites in the Scattered Small Tracts are aboriginal manifestations of unknown age or affiliation, five are Fremont, one is Numic (i.e., probably Ute), two have Archaic components, one is Historic Euro-American (not including a small Historic component at a rockshelter site), and one is paleontological. The remaining site is an aboriginal locus which yielded an Elko Corner-notched point and, thus, is possibly of Archaic or Fremont derivation. For the purposes of predictive modelling, data from the 24 prehistoric sites in the Scattered Small Tracts were combined with Class I information on the Elmo and Emery Tracts; the nine sites within the Desert Shrub vegetation community were added to the Elmo Tract data and the remaining 15 were included in the analyses for the Emery Tract. This procedure, while somewhat arbitrary, was necessary to supplement the limited data available for the entire Elmo Tract region and--due to the total absence of pinyon-juniper woodlands in the latter area--was undertaken with the recognition that vegetation patterning was one of the obvious distinctions between the Elmo and Emery Tracts. Site significance evaluations are summarized in Table 11; see Chapter 5 for more details on criteria used in evaluating National Register eligibility and significance.

Three of the 26 sites deserve further discussion regarding NRHP eligibility. Site 42EM2064, a historic habitation on the outskirts of Emery, has been evaluated eligible for the NRHP based on its architectural significance. Stabilization of the standing structures and architectural preservation are the main recommendations for this site. Site 42EM2065, a large Fremont camp with a small rockshelter locus, was test excavated by BLM personnel due to impending land action on the 40-acre parcel #25 adjacent to the town of Emery (Miller n.d.). This work established that the site lacks intact prehistoric buried material, and that further excavations are not likely to yield more information beyond that already collected. Thus, the site is ineligible for the NRHP and no further work is recommended. Site 42EM2066 (MZ-1238), the Bailey Butte Site west of Ferron, is a probable Fremont habitation well-known by locals that is eligible for the NRHP based on surface evidence alone. Both surface masonry and semi-subterranean pit structures are present here, as well as abundant artifacts with a relatively high percentage of tools represented. This site should be extensively excavated if development or a change in land status threatens its integrity.

Table 11
Site Significance Evaluations for the SSTs

Site # (42EM-)	SST Parcel #	EVALUATION Eligible	Potentially Eligible	Not Eligible	Recommendations For the Future
2056	14			X	No further work
2057	18			X	No further work
2058	20			X	No further work
2059	20			X	No further work
2060	20		X		Avoid or test
2061	20			X	No further work
2062	20		X		Salvage hearth soon; test excavate
2063	19			X	No further work
2064	25	X			Preserve arch integrity
2065	25			X	No further work
2066	20	X			Avoid or excavate
2067	24			X	No further work
2068	23		X		Avoid or test
2069	23		X		Avoid or test
2070	23			X	No further work
2071	23			X	No further work
2072	23			X	No further work
2073	23		X		Avoid or test
2074	13			X	No further work
2075	13			X	No further work
2076	13			X	No further work
2077	15			X	No further work
2078	23		X		Avoid or test
2079	23		X		Avoid or test
2080	23			X	No further work
2082	7			X	No further work

The other seven sites judged potentially eligible for the NRHP should be avoided and preserved if possible, or test excavated to definitively assess their eligibility and determine what further course of action, if any, need be taken. The single paleontological site among the 16 ineligible resources, 42EM2082, is a concentration of fragmented fossil marine invertebrates for which no further work is recommended because of the condition of the fossils--not because the fossils themselves are insignificant. Fossil species were identified by James Kirkland and Jeff Eaton (1985), and include the ammonite *Placenticeras* sp., the giant clam *Inoceramus platinus* and an oyster, *Pseudoperna congesta*. They are representative of the Santonian division of the Upper Cretaceous Blue Gate Shale (Katich 1956; Moore *et al*. 1952:385-386, 430-432).

The Elmo Tract

Between July 18 and July 25, 1984 a total of 2,800 acres (1,133 ha) in thirty-five 80-acre sample units was surveyed in the Elmo Tract in the northern portion of Castle Valley (Figure 2). The inventoried lands represent 20% of the 14,000 acre study tract as defined by the BLM. This survey resulted in the discovery of eight sites and 36 IFs; six of the sites and 24 of the IFs are of prehistoric aboriginal origin. Appendices 2-1 and 2-4 provide detailed information on each of these resources, while Tables 12 and 13 summarize locational data and site type-environmental correlates for the six sites. Table 14 combines data from the Elmo Tract with information on the nine sites from the Scattered Small Tracts which are located in settings typical of the Elmo area.

These data, being so sparse, are inconclusive but do show that valley bottom and valley margin settings were preferred site locations--not surprising given the aridity of the tract. The fact that all but one of the sites is in the Desert Shrub vegetation community is virtually meaningless since such flora, especially shadscale-grassland associations, cover most of the tract. The six prehistoric sites and 24 aboriginal IFs have yielded almost no diagnostic lithic artifacts and no ceramic sherds. Only one site and one IF have reasonably complete projectile points, both arrow point fragments indicative of Late Prehistoric period (post-AD 250) occupations. Two of four other isolated point blade fragments also may date to the Late Prehistoric. Cultural affiliations within the Elmo Tract, apart from Historic period Euro-American resources, remain unknown but a Fremont presence is suggested. The six aboriginal sites include three short-term camps, one (faunal?) processing site and two low diversity chipping stations. Thus, no quarries were located in the Elmo Tract, even though several were identified in the more arid portions of the Scattered Small Tracts. This circumstance is entirely due to the general lack of preserved pediment gravels containing knappable cobbles of tool stone in the Elmo area.

The presence of both multiple and limited activity sites in the tract confirms that aboriginal occupation of the area was not solely for the purpose of procuring tool stone or as a mere transportation corridor to get to more desirable terrain to the east or west. However, the lack of habitation sites and overall very low site density suggest that prehistoric groups here were both limited in numbers and limiting their stay in any given area to relatively brief periods of time. Both Historic

Table 12
Locational Data for Sites in the Elmo Tract

Perm Site #	Sample Unit #	Elevation	Vegetation*	Landform	Nearest Perm Water	Site Type**
42CB447	21	5,475 ft	d.s./shadscale	valley edge	1,900 m	short-term camp
42CB448	19	5,400 ft	d.s./shadscale	valley edge	1,100 m	Historic camp
42EM1981	109	5,505 ft	d.s./dry meadow	ridge	5,450 m	processing
42EM2052	58	5,400 ft	d.s./shadscale	valley interior	65 m	chipping-LD
42EM2053	58	5,380 ft	d.s./shadscale	valley interior	125 m	short-term camp
42EM2054	96	5,420 ft	Big sagebrush	valley interior	4,550 m	short-term camp
42EM2055	96	5,420 ft	d.s./shadscale	valley interior	4,580 m	chipping-LD
42EM2081	87	5,520 ft	d.s./shadscale	ridge	950 m	Historic camp

* d.s.= desert shrub
** LD = low diversity

Table 13
Correlation Matrix: Environmental Variables vs Site Types in the Elmo Tract

	Vegetation				Elevation(ft)				Landform								Horiz Dist to Nearest Perm Water					
	PJ	DS	BS	RP	5-55	55-6	6-65	65-7	BT	RT	MI	MR	HS	TR	BN	VE	A	B	C	D	E	F
S-T Camp	0	2	1	0	3	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	1	1
Processing	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Chipping-LD	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	1
Historic	0	2	0	0	1	1	0	0	0	1	0	0	0	0	0	1	0	0	1	1	0	0
Totals	0	7	1	0	6	2	0	0	0	2	0	0	0	0	0	6	1	1	1	1	1	3

Key:

S-T = Short-Term
LD = Low Diversity
PJ = Pinyon-Juniper
DS = Desert Shrub
BS = Big Sagebrush
RP = Riparian
5-55 = 5000-5499
55-6 = 5500-5999
6-65 = 6000-6499
65-7 = 6500-7000
BT = Butte Top
RT = Ridge Top
MI = Mesa Interior
MR = Mesa Rim
HS = Hillslope
TR = Terrace
BN = Bench
VE = Valley Edge
A = 0-99m
B = 100-499m
C = 500-999m
D = 1-1.49 km
E = 1.5-1.99km
F = 2km or more

Table 14
Correlation Matrix: Environmental Variables vs Site Types in the Elmo Tract & SSTs

	Vegetation				Elevation(ft)				Landform								Horiz Dist to Nearest Perm Water					
	PJ	DS	BS	RP	5-55	55-6	6-65	65-7	BT	RT	MI	MR	HS	TR	BN	VE	A	B	C	D	E	F
S-T Camp	0	2	1	0	3	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	1	1
Processing	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Chipping-LD	0	4	0	0	2	2	0	0	0	0	0	0	0	0	0	4	1	0	2	0	0	1
Quarry	0	7	0	0	0	4	2	1	0	3	1	1	0	0	0	2	0	1	1	3	1	1
Historic	0	3	0	0	1	1	1	0	0	1	0	0	0	0	0	2	1	0	1	1	0	0
Totals	0	17	1	0	6	8	3	1	0	5	1	1	0	0	0	11	2	2	4	4	2	4

Key:

S-T = Short-Term	6-65 = 6000-6499	BN = Bench
LD = Low Diversity	65-7 = 6500-7000	VE = Valley edge
PJ = Pinyon-Juniper	BT = Butte Top	A = 0-99m
DS = Desert Shrub	RT = Ridge Top	B = 100-499m
BS = Big Sagebrush	MI = Mesa Interior	C = 500-999m
RP = Riparian	MR = Mesa Rim	D = 1-1.49km
5-55 = 5000-5499	HS = Hillslope	E = 1.5-1.99km
55-6 = 5500-5999	TR = Terrace	F = 2km or more

period sites are short-term camps that are located with clear views of large drainages.

In terms of site significance and NRHP eligibility, five of the eight sites are insignificant resources that are ineligible for the NRHP and for which no further work is recommended. The remaining three sites (42EM2053-2055) are all potentially eligible for the NRHP and should be avoided if future land-disturbing impacts threaten them. Should avoidance not be possible, all three should be test excavated to determine what further course of action might be necessary; exposed hearths as at 42EM2053 should be salvaged during such testing for data relating to subsistence, local chronology, etc. All IFs are inherently insignificant resources for which no further work is required.

Emery Tract

From August 1 to August 19, 1984 and again from September 19 to October 13, 1984 a total of 3,680 acres (1,489 ha) in forty-six 80-acre sample units was surveyed in the Emery Tract in the southern portion of Castle Valley (Figure 4). The total represents 9.9% of the 37,000 acre study area delimited by the BLM, or 10.2% of the 451 units defined in the sample universe. This survey resulted in the discovery of 109 sites (nine of which were previously recorded) and 77 IFs. Ninety-nine of the sites are aboriginal, four are Historic period Euro-American manifestations, and six have both prehistoric and historic components; 73 of the IFs are aboriginal, three are Euro-American and one (EMIF-251-3) has both aboriginal and Euro-American artifacts. Tables 15 and 16 summarize locational data and site type-environmental correlates for the 109 sites, while information on individual sites and IFs is tabulated in Appendices 2-3 and 2-6. As mentioned before, two of the nine previously recorded sites in the Emery Tract were not re-recorded: 42EM152 and 42EM770.

In the Emery Tract, the 109 recorded sites include fourteen habitations, 29 short-term camps, nine medium-diversity chipping stations, six rockshelter sites, four processing sites, fifteen quarries, 37 low-diversity chipping stations and ten Historic period manifestations. The number of site types exceeds 109 because some sites exhibit more than one activity locus of different functions, this being particularly true for quarries of which seven occur in association with components unrelated to tool stone procurement. Table 16 shows that there is a preference among

Table 15
Locational Data for Sites in the Emery Tract

Perm Site #	Sample Unit #	Elevation (feet)	Vegetation *	Landform	Nearest Perm Water(m)	Site Type**
42EM1982	40 & 41	7,060	pinyon-juniper	ledge/mesa rim	4,750	rockshelter
1983	40	7,040	pinyon-juniper	mesa top	4,600	chipping-LD
1984	40	7,030	pinyon-juniper	mesa top	4,400	chipping-LD
1985	40	7,020	pinyon-juniper	mesa top	4,250	short-term camp
1986	40	7,010	pinyon-juniper	mesa top	4,200	chipping-LD
1987	40	7,120	pinyon-juniper	mesa rim	4,900	chipping-LD & quarry
1988	40	7,100	pinyon-juniper	mesa top	4,750	chipping-LD & quarry
1989	40	7,020	pinyon-juniper	mesa top	4,400	chipping-LD
1990	40	6,980	pinyon-juniper	mesa top	4,000	chipping-LD
1991	40	7,020	pinyon-juniper	mesa top	4,100	chipping-LD
1992	40 & 45	7,020	pinyon-juniper	mesa top	4,000	chipping-MD
1993	45	7,120	pinyon-juniper	mesa rim	4,650	chipping-LD & quarry
1994	45	7,100	pinyon-juniper	mesa top	4,500	chipping-LD
1995	45	7,020	pinyon-juniper	mesa top	4,100	chipping-LD
1996	45	7,060	pinyon-juniper	mesa top	4,350	chipping-MD
1997	227	5,760	d.s./shadscale	ridgetop	1,150	quarry
1998	227	5,760	d.s./shadscale	ridge toe	1,100	quarry
42SV5	337	6,520	d.s./shadscale	terrace	50	habitation
2033	125	6,380	pinyon-juniper	mesa rim	1,450	short-term camp
2034	125	6,340	pinyon-juniper	valley head	1,400	habitation
2035	125	6,380	pinyon-juniper	bench	1,300	short-term camp
2036	125	6,300	pinyon-juniper	valley head	1,400	Historic fench
2037	67	6,400	pinyon-juniper	valley margin	3,650	Historic camp
2038	67	6,870	pinyon-juniper	mesa top	3,500	chipping-LD
2039	67	6,860	pinyon-juniper	mesa top	3,400	chipping-LD
2040	67	6,840	pinyon-juniper	mesa rim	3,350	chipping-LD
2041	137	6,300	pinyon-juniper	bench	600	Historic fence

Table 15 (continued)

Perm Site #	Sample Unit #	Elevation (feet)	Vegetation*	Landform	Nearest Perm Water(m)	Site Type**
42EM669	251	6,160	pinyon-juniper	valley edge	2,250	rockshelter
770	234	6,400	pinyon-juniper	mesa rim	1,000	processing/Hist trash
1999	173	5,685	d.s./shadscale	terrace	30	short-term camp
2000	173	5,680	d.s./shadscale	terrace	75	chipping-LD
2001	173	5,680	d.s./shadscale	terrace	75	short-term camp
2002	173	5,660	d.s./shadscale	valley bottom	115	short-term camp
2003	173	5,640	d.s./shadscale	terrace	20	short-term camp
2004	173	5,680	d.s./shadscale	terrace	100	short-term camp
2005	173	5,660	d.s./shadscale	terrace	40	short-term camp
2006	42	6,220	pinyon-juniper	ridgetop	6,500	habitation-rockshelter
2007	251	6,370	pinyon-juniper	mesa rim	2,400	short-term camp
2008	451	6,060	d.s./shadscale	ridge slope	1,250	quarry
2009	234	6,300	pinyon-juniper	saddle	2,100	chipping-LD
2010	234	6,280	pinyon-juniper	mesa slope	2,000	quarry
2011	445	6,580	pinyon-juniper	mesa rim	1,000	chipping-MD
2012	206	6,080	pinyon-juniper	valley slope	1,200	short-term camp
2013	206	6,160	pinyon-juniper	bench	1,000	short-term camp
42SV438	137	6,280	pinyon-juniper	bench	1,000	short-term camp/Hist trash
439	137	6,320	pinyon-juniper	bench	1,200	short-term camp
440	137	6,280	d.s./grassland/p-j	ridgetop	1,150	short-term camp
2042	137	6,220	pinyon-juniper	bench	1,100	short-term camp
2043	137	6,300	p-j/grassland	bench	1,100	processing
2044	137	6,380	pinyon-juniper	bench	1,200	short-term camp
2045	274	6,620	pinyon-juniper	mesa rim	1,100	prehistoric/Hist camp
2046	259	6,500	pinyon-juniper	mesa rim	800	chipping-LD
2047	259	6,485	pinyon-juniper	hillslope	850	short-term camp/quarry
2048	290	6,620	pinyon-juniper	hillslope	750	chipping-MD/quarry

Table 15 (continued)

Perm Site #	Sample Unit #	Elevation (feet)	Vegetation*	Landform	Nearest Perm Water(m)	Site Type**
42EM2014	132	6,240	pinyon-juniper	valley head	600	processing
2015	132	6,270	pinyon-juniper	mesa top	800	short-term camp
2016	441	5,980	d.s./shadscale	terrace	2,800	chipping-LD
2017	273	5,800	d.s./shadscale	bench	150	chipping-LD
2018	273	5,680	d.s./shadscale	saddle	140	quarry
2019	29	6,860	pinyon-juniper	mesa top	2,900	habitation
2020	258	5,800	d.s./shadscale	mesa rim	1,200	chipping-LD
2021	258	5,800	d.s./shadscale	mesa rim	1,200	chipping-LD
2022	258	5,800	d.s./shadscale	mesa rim	1,400	chipping-LD
2023	348	6,010	pinyon-juniper	ridge	3,050	chipping-LD
2024	336/348	6,020	d.s./shadscale	ridge	2,950	chipping-MD
2025	348	5,900	d.s./shadscale	valley edge	3,550	quarry
2026	258	5,840	pinyon-juniper	bench	1,700	habitation
2027	29	6,920	pinyon-juniper	mesa top	3,650	chipping-LD
2028	29	6,940	pinyon-juniper	mesa top	3,750	chipping-LD
2029	111	5,750	d.s./shadscale	valley margin	325	chipping-LD
2030	269	6,700	pinyon-juniper	mesa top	2,375	chipping-LD
2031	313	6,760	pinyon-juniper	mesa top	3,750	chipping-MD
2032	313	6,800	pinyon-juniper	mesa rim	3,850	chipping-MD
2033	132	6,280	pinyon-juniper	mesa top	850	rockshelter
2034	132	6,240	pinyon-juniper	mesa top	950	habitation
2035	441	5,920	d.s./shadscale	valley interior	3,200	chipping-LD
2036	441	5,920	d.s./shadscale	valley interior	3,450	chipping-LD
42SV2049	201	6,140	pinyon-juniper	valley margin	550	chipping-LD
2050	201	6,140	pinyon-juniper	valley margin	550	chipping-LD
2051	201	6,280	pinyon-juniper	bench	800	chipping-LD
2052	290	6,680	pinyon-juniper	mesa rim	600	chipping-LD
2053	274	6,640	pinyon-juniper	mesa rim	850	camp/quarry/Hist trash
2054	274	6,540	pinyon-juniper	mesa rim	850	short-term camp

Table 15 (continued)

Perm Site #	Sample Unit #	Elevation (feet)	Vegetation*	Landform	Nearest Perm Water(m)	Site Type**
42SV474	421	6,400	pinyon-juniper	canyon/mesa rim	1,050	habitation
2055	421	6,400	pinyon-juniper	valley head	1,450	rockshelter
2056	421	6,350	pinyon-juniper	bench	1,600	chipping-LD
2057	421	6,440	pinyon-juniper	canyon/mesa rim	1,400	chipping-LD
2058	385	6,480	P-J/shadscale	mesa top	2,100	short-term camp
2059	385	6,480	pinyon-juniper	mesa top	2,250	short-term camp
2060	385	6,460	pinyon-juniper	mesa top	2,300	short-term camp
2061	385	6,480	pinyon-juniper	mesa top	2,450	chipping-MD
2062	385	6,445	pinyon-juniper	valley head	2,125	habitation
42EM152	234?	6,280	pinyon-juniper	bench	1,200	Hist camp
1256	336	5,940	pinyon-juniper	bench/butte	4,650	chipping-MD
2037	206	6,260	pinyon-juniper	mesa slope	1,000	chipping-LD
2038	206	6,280	pinyon-juniper	mesa rim	900	short-term camp
2039	206	6,230	pinyon-juniper	mesa slope	1,350	quarry
2040	206	6,160	pinyon-juniper	bench	800	processing
2041	206	6,100	pinyon-juniper	bench	1,000	quarry
2042	2	6,340	pinyon-juniper	mesa top	4,850	habitation/rockshelters
2043	2	6,280	d.s./shadscale/p-j	valley margin	4,600	short-term camp
2044	5/8	6,360	pinyon-juniper	mesa top	5,000	habitation
2045	5	6,380	pinyon-juniper	ridge	4,500	habitation/Hist camp
2046	5	6,300	d.s./shadscale	valley margin	4,300	chipping-LD
2047	336	5,960	pinyon-juniper	bench	4,500	habitation
2048	20/25	6,900	pinyon-juniper	mesa top	3,600	habitation/Hist camp
2049	111	5,730	d.s./shadscale	valley margin	125	chipping-LD
2050	111	5,740	d.s./shadscale	valley margin	150	short-term camp
2051	111	5,720	d.s./shadscale	ridge	60	habitation/quarry

* d.s.= desert shrub
** LD = low diversity, MD = medium diversity

Table 16
Correlation Matrix: Environmental Variables vs Site Types in the Emery Tract

	Vegetation				Elevation(ft)				Landform											Horiz Dist to Nearest Perm Water				
									Valley				Mesa											
	PJ	PJE	SD	GL	55-6	6-65	65-7	7-75	TR	MG	BT	RB	TP	RM	SL	BN	CV	SD	A	B	C	D	E
Habitation	12	0	2	0	3	8	3	0	1	0	0	3	5	1	0	2	2	0	2	0	1	2	1
S-T Camp	18	3	7	0	7	17	3	1	5	3	1	1	5	6	1	6	0	0	4	3	5	10	0
Chipping-MD	8	0	1	0	1	2	4	2	0	0	0	2	4	2	1	0	0	0	0	0	1	1	0
Processing	3	1	0	0	0	4	0	0	0	0	0	0	0	1	0	2	1	0	0	0	2	2	0
Chipping-LD	27	0	11	0	10	9	9	10	4	5	0	1	14	9	1	3	0	1	1	3	5	5	1
Quarry	9	0	6	0	5	5	2	3	0	1	0	3	1	3	5	1	0	1	1	2	3	4	0
Rockshelter	6	0	0	0	0	5	0	1	0	1	0	1	2	1	0	0	1	0	0	0	1	0	1
Historic	10	0	0	0	0	7	3	0	0	1	0	1	1	3	0	3	1	0	0	0	2	5	0
Totals	93	4	27	0	26	57	24	17	10	11	1	12	32	26	8	17	5	2	8	8	20	29	3

Key:

S-T = Short-term
MD = Medium Diversity
LD = Low Diversity
PJ = Pinyon-Juniper
PJE = Pinyon-Juniper Ecotone
SD = Shadscale
GL = Grassland
55-6 = 5500-5999
6-65 = 6000-6499
65-7 = 6500-6999
7-75 = 7000-7499
TR = Terrace
MG = Margin
BT = Bottom
RB = Ridge/Butte
TP = Top
RM = Rim
SL = Slope
BN = Bench
CV = Canyon/Valley Head
SD = Saddle
A = 0-99m
B = 100-499m
C = 500-999m
D = 1-1.49km
E = 1.5-1.99km
F = 2km or more

all site types for pinyon-juniper woodlands; multiple activity sites and Historic locations also tend to occur at elevations between 6,000 and 6,500 ft (i.e., on landforms immediately above valleys), with limited activity sites more randomly distributed. Overall, sites of all types are more common on and around the various mesas in the tract, rather than crowded only along valleys. This fact is confirmed by the distance to reliable water statistic, showing that proximity to water was not always crucial in settlement location decision-making.

Considered in combination with the observation that tool diversity is low at most sites in the study tract (only 18 of 105 aboriginal sites have four or more tool classes present), these data show that prehistoric sites in the Emery area were occupied only seasonally in most cases, with few year-round habitations like Snake Rock Village or the Bailey Butte Site present. Fremont groups here were less mobile than their Archaic stage predecessors but the population as a whole was far from sedentary on a year-long basis, as many researchers have pointed out (e.g., Lohse 1980: 49-54).

Diagnostic artifacts have been recovered from 37 of the 105 aboriginal sites within the Emery Tract, 22 of which yielded Fremont ceramics (see Appendix 2-3). In sum, suggested age assignments for individual site components can be broken down as follows: Paleo-Indian period, six possible components; Archaic period, 16 components; Late Prehistoric period of uncertain affiliation, five components; Late Prehistoric-Fremont, 22 components; Late Prehistoric-Numic, no components; and unknown age or affiliation, 67 sites. Five sites of unknown age/affiliation yielded nondiagnostic Elko series points, which may be Archaic or Fremont in age (Holmer 1978). Again, the number of dated components exceeds 37 because some sites yielded evidence of occupation during more than one time period. Many sites of Late Prehistoric-unknown affiliation and sites without diagnostic artifacts probably are of Fremont affiliation, particularly sites with large midden-like burned rock features (e.g., 42SV2034).

In terms of NRHP eligibility, Table 17 summarizes significance evaluations for the 109 Emery Tract sites; all 77 IFs are inherently insignificant resources for which no further work is required. Of the 109 sites one is eligible for the NRHP based on present evidence alone (42SV5, i.e. Snake Rock Village), 52 are potentially eligible and 56 are

Table 17
Site Significance Evaluations for the Emery Tract

Site # (42--)	* NRHP Eligibility	Site #	* NRHP Eligibility	Site #	* NRHP Eligibility
EM152	N	EM2014	P	EM2050	N
669	P	2015	P	2051	N
770	N	2016	N	SV5	E
1256	N	2017	N	438	P
1982	P	2018	N	439	P
1983	N	2019	P	440	P
1984	P	2020	N	474	P
1985	N	2021	N	2033	P
1986	P	2022	N	2034	P
1987	N	2023	N	2035	P
1988	N	2024	P	2036	N
1989	P	2025	N	2037	N
1990	P	2026	P	2038	P
1991	N	2027	N	2039	N
1992	P	2028	N	2040	N
1993	P	2029	N	2041	N
1994	N	2030	N	2042	P
1995	N	2031	P	2043	P
1996	P	2032	N	2044	P
1997	N	2033	P	2045	N
1998	P	2034	P	2046	P
1999	N	2035	P	2047	N
2000	P	2036	N	2048	N
2001	P	2037	N	2049	N
2002	P	2038	P	2050	N
2003	P	2039	N	2051	P
2004	N	2040	N	2052	N
2005	P	2041	N	2053	P
2006	P	2042	P	2054	P
2007	P	2043	N	2055	P
2008	N	2044	P	2056	N
2009	N	2045	P	2057	N
2010	N	2046	N	2058	P
2011	P	2047	N	2059	P
2012	N	2048	P	2060	P
2013	N	2049	N	2061	N
				2062	P

* E = eligible, P = potentially eligible, N = not eligible

ineligible based on surface indications. No further work is recommended for the 56 ineligible sites; avoidance is recommended for the 52 potentially eligible sites, but if that is not possible then test excavations should be conducted in threatened areas to determine what further course of action to take, if any. The recommendation for eligible site 42SV5 is to conduct further excavation using state-of-the art data recovery methods, since earlier work was conducted long ago following less detailed research strategies than are possible today.

Artifacts

Inventory of the three study tracts resulted in the locating of 143 sites and 143 IFs, but collections were limited almost entirely to diagnostic potsherds and projectile points; representative samples of the full range of artifacts found in these areas were not taken. Artifacts were collected from 48 sites and 25 IFs, with a total of 188 items recovered. Those 188 artifacts include 99 potsherds from 18 sites (nine other sites yielded ceramics, but no collections were taken there), six sherds from four IFs, 50 projectile points and fragments from 34 sites, 17 points and point fragments from 17 IFs, plus four drills, two obsidian artifacts, 1 worked shell fragment, three bifaces, two stemmed scrapers and four Historic glass bottles.

The 67 projectile points in the collection--more properly termed hafted bifaces since not all were used as weapon tips (cf. Ahler 1971)--include three types of probable Paleo-Indian age, 15 Archaic types and six Late Prehistoric period types. Elko and Gypsum series points are most heavily represented, but early forms are not uncommon and Formative age (Fremont) styles are less common than expected. Below are provided descriptions of the collected chipped stone, with metric data for the 78 lithic items presented in Table 18. See Appendix 7 for a complete listing of the 188 collected artifacts.

Type: Lake Mojave
No. of Specimens: 4
Provenience: 42EM1988, 1992, 2024 and 2043
Illustration: Figure 13
Material Types: chalcedony (50%), chert (25%), quartzite (25%)

Table 18
Chipped Stone Data

Site/IF (42--)	Cat. No.	Material	Max. Dimensions (cm) L	W	T	S/NW	Flaking Pattern	Func-tion(s)	Type
EM1988	1	chalcedony	6.36	2.76	0.79	1.74	collateral	proj pt	Lake Mojave
EM1992	1	quartzite	6.37	2.43	0.88	1.68	collateral	proj pt	Lake Mojave
EM2024	1	chalcedony	3.87	2.30	0.56	1.45	collateral	proj pt	Lake Mojave
EM2043	1	chert	---	(1.97)	0.62	1.27	unknown	proj pt	Lake Mojave
EMIF-427-2		chert	6.46	2.58	0.84	1.88	par-transv	proj pt	Lovell Constricted?
EM1988	2	chert	(3.95)	(1.92)	0.63	---	par-oblique	proj pt	Plano tradition
EM2032	1	chalcedony	(2.95)	2.32	0.65	---	par-oblique	proj pt	Plano tradition
EMIF-67-2		chert	(2.38)	2.28	0.46	---	par-oblique	proj pt	Plano tradition
EMIF-385-8		chalcedony	4.74	2.03	0.36	---	par-oblique	proj pt	Humboldt
SV474	4	chalcedony	(4.63)	(1.72)	0.63	---	collateral	proj pt	Black Rock CB
SV474	2	chert	(2.11)	1.35	0.51	---	collateral	proj pt	Pinto Shoulderless
EMIF-45-3		chert	---	(1.77)	0.45	---	collateral	proj pt	Pinto Shoulderless
EM1993	2	chalcedony	(4.17)	2.78	0.68	1.64	collateral	proj pt	Pinto Shouldered
EM2019	6	chert	(2.71)	1.71	0.59	1.28	collateral	proj pt	Pinto Shouldered
SV2045	1	chert	---	2.35	0.34	1.35	unknown	proj pt	Northern Side-Notched
EM2022	1	chert	(3.32)	2.08	0.43	1.37	collateral	knife?	Hawken Side-Notched
EMIF-132-1		chalcedony	4.00	1.71	0.52	1.34	par-oblique	proj pt	Hawken Side-Notched
EM2011	1	chalcedony	(3.64)	2.86	0.68	1.94	collateral	proj pt	Sudden Side-Notched
EM2024	2	chalcedony	3.28	1.80	0.52	1.37	par-transv	proj pt	Duncan (McKean complex)
SV2062	1	chert	---	(1.57)	0.41	1.29	unknown	proj pt	Duncan (McKean complex)
EM2044	1	chalcedony	(3.24)	1.87	0.54	0.96	collateral	proj pt	Summit Stemmed
EMIF-274-3		chalcedony	(2.38)	(1.71)	0.48	1.41	unknown	proj pt?	Summit Stemmed
EM2070	1	chert	(4.48)	2.51	0.59	1.41	collateral	proj pt	Elko Eared
EM1993	1	chalcedony	(3.66)	2.21	0.57	1.45	collateral	proj pt	Gypsum
EM1996	1	chalcedony	4.04	2.11	0.69	1.56	collateral	scraper?	Gypsum
EM2006	1	chalcedony	(3.40)	1.93	0.46	0.98	collateral	proj pt	Gypsum
EM2019	1	chalcedony	(3.89)	2.54	0.64	1.28	collateral	proj pt	Gypsum
EM2047	1	chert	6.14	2.75	0.75	1.40	chevron	proj pt	Gypsum

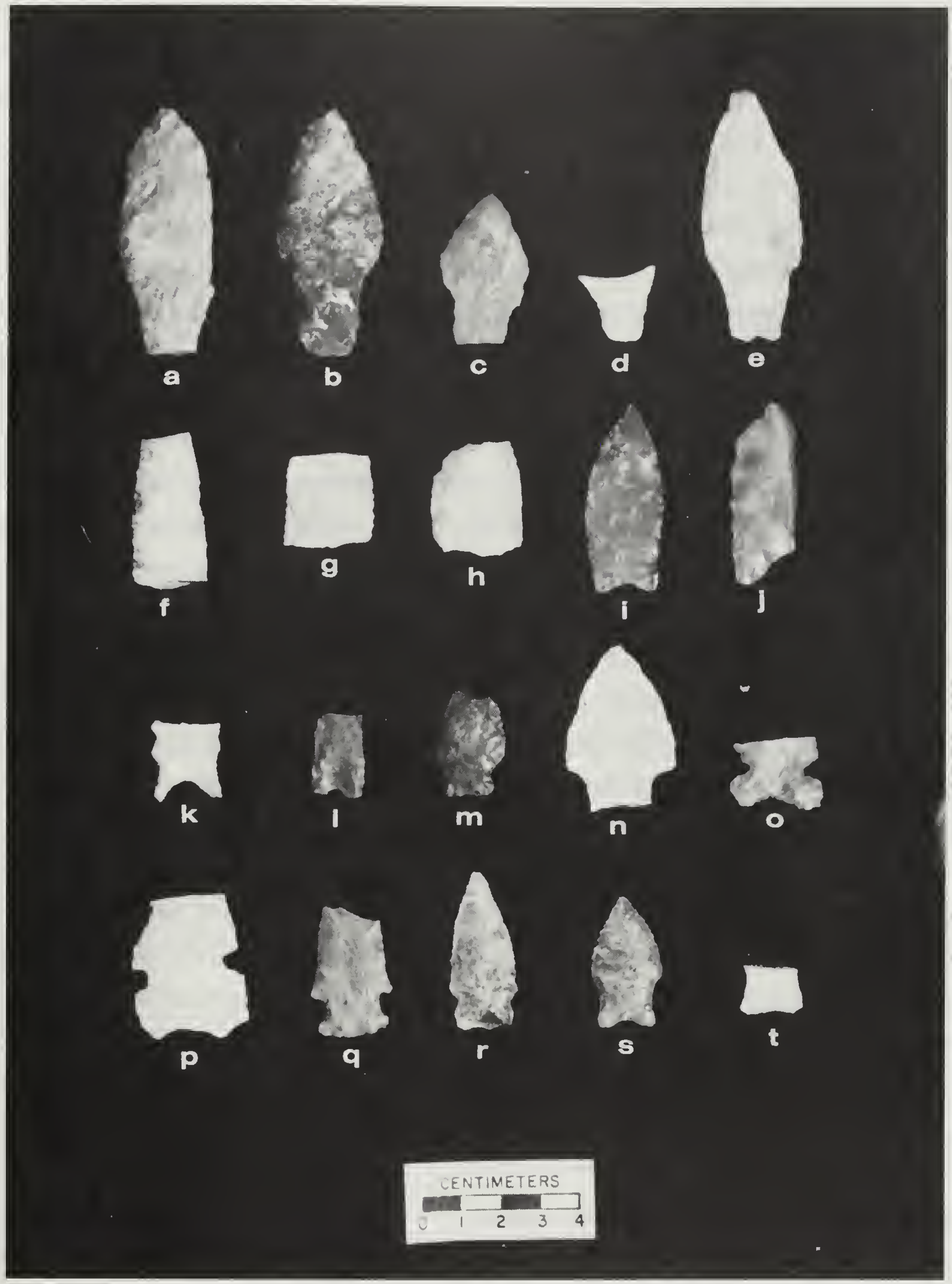
Table 18 (continued)

Site/IF (42--)	Cat. No.	Material	Max. Dimensions (cm) L	W	T	S/NW	Flaking Pattern	Func-tion(s)	Type
EM2063	1	chalcedony	(3.55)	1.47	0.48	1.11	collateral	proj pt	Gypsum
SV2033	1	chert	3.42	2.47	0.55	1.18	collateral	proj pt	Gypsum
SV2048	1	chert	(2.50)	1.72	0.54	0.96	collateral	proj pt	Gypsum
EMIF-43-4		chert	(4.22)	2.36	0.39	1.07	collateral	knife	Gypsum
EMIF-274-2		chalcedony	(3.74)	2.12	0.58	1.10	collateral	proj pt	Gypsum
EMIF-385-2		chert	(4.19)	2.09	0.65	1.12	collateral	proj pt	Gypsum
EM2044	3	chalcedony	(3.15)	2.36	0.58	1.29	collateral	proj pt	Elko Side-Notched
SV439	1	chert	3.32	2.34	0.47	1.65	collateral	knife?	Elko Side-Notched
EM1256	1	chert	---	(1.40)	(0.31)	1.18	unknown	unknown	Elko Corner-Notched
EM1256	2	chert	(1.85)	(2.00)	0.43	1.37	unknown	unknown	Elko Corner-Notched
EM1987	1	chalcedony	(2.33)	2.17	0.51	1.24	collateral	proj pt	Elko Corner-Notched
EM1995	1	chert	(3.23)	2.27	0.46	0.96	collateral	proj pt	Elko Corner-Notched
EM2019	2	chert	(3.51)	(2.22)	0.46	1.00	collateral	proj pt	Elko Corner-Notched
EM2047	2	chert	(1.83)	2.38	0.40	1.47	unknown	reworked knife	Elko Corner-Notched
EM2069	1	chert	(4.18)	2.70	0.57	1.71	collateral	knife?	Elko Corner-Notched
SV474	5	chalcedony	(2.78)	2.13	0.45	1.10	collateral	proj pt	Elko Corner-Notched
SV2060	1	quartzite	(3.33)	2.66	0.47	1.24	collateral	proj pt	Elko Corner-Notched
ELIF-41-1		chalcedony	(2.21)	2.22	0.59	1.11	collateral	scraper?	Elko Corner-Notched
EMIF-251-2		siltstone	(6.78)	3.32	0.62	1.29	collateral	proj pt	Elko Corner-Notched
EM2019	5	chert	(1.98)	(2.49)	0.37	1.63	collateral	graver?	Elko(?)-4 notches
EM2024	3	chalcedony	(4.30)	(2.00)	0.53	0.82	collateral	saw?	Elko(?)-deeply serrated
EM2010	1	chalcedony	(3.32)	1.57	0.51	---	collateral	proj pt	dart blade frag
ELIF-50-1		chalcedony	(2.43)	(2.13)	0.50	---	collateral	proj pt	dart blade frag
EM1993	3	chert	2.92	2.18	0.40	1.09	collateral	proj pt	Late Prehis Corner-Notch
ELIF-1-1		chert	(3.48)	1.82	0.45	1.01	collateral	proj pt	Late Prehis Corner-Notch
EM2053	1	chert	2.29	1.30	0.36	0.53	collateral	proj pt	Rose Spring Corner-Notch
EM2068	6	chalcedony	(2.99)	1.32	0.41	0.55	chevron	proj pt	Rose Spring Corner-Notch

Table 18 (continued)

Site/IF (42--)	Cat. No.	Material	Max. Dimensions (cm) L	W	T	S/NW	Flaking Pattern	Func-tion(s)	Type
SV474	1	quartzite	(1.24)	1.06	0.25	0.37	unknown	proj pt	Rose Spring Corner-Notch
SST-IF-1		chert	(2.79)	1.35	0.51	1.00	par-transv	proj pt	Sinbad Side-Notched
EM2079	1	chalcedony	2.20	1.34	0.29	0.97	chevron	proj pt	Desert Side-Notched
EMIF-67-3		chalcedony	2.50	1.42	0.32	0.87	chevron	proj pt	Desert Side-Notched
EM2065	6	chalcedony	1.76	1.36	0.31	---	random	proj pt	Cottonwood Triangular
SV2034	1	chert	2.59	1.10	0.38	---	collateral	proj pt	Cottonwood Triangular
EM1996	2	chert	(1.95)	1.75	0.44	---	chevron	proj pt	arrow point frag
EM2016	1	chalcedony	(1.78)	1.32	0.36	---	chevron	proj pt	arrow point frag
EM2066	3	quartzite	(1.33)	(0.82)	0.30	---	unknown	proj pt	arrow point frag
SV2046	1	chert	(2.21)	(1.41)	0.35	---	collateral	proj pt	arrow point frag
ELIF-27-2		chert	(1.56)	(1.87)	0.44	---	random	proj pt	arrow point frag
ELIF-147-1		chalcedony	(2.14)	(1.61)	0.27	---	chevron	proj pt	arrow point frag
EM2065	13	quartzite	(2.17)	1.60	0.38	---	random	proj pt?	biface frag
EM2066	4	chert	(3.00)	2.59	0.55	---	collateral	unknown	biface frag
SST-IF-I		chert	(4.18)	2.50	0.87	---	random	unknown	biface frag
EM2019	3	chert	5.33	(1.70)	0.54	---	collateral	drill	expanding base
EM2026	1	chalcedony	1.94	2.12	0.49	1.54	random	drill	side-notched
EM2026	2	chalcedony	2.73	1.65	0.43	1.43	par-oblique	drill	side-notched
EM2026	3	chalcedony	(1.98)	(1.91)	0.47	1.13	random	drill	stemmed, indented base
EM2006	2	chert	(4.76)	2.65	0.74	1.58	par-transv	scraper	stemmed (reworked Scotts-bluff pt?)
EM2019	4	chalcedony	(3.77)	2.56	0.81	1.71	collateral	scraper	single shouldered
EM2045	1	obsidian	(3.10)	(3.15)	0.43	---	---	debitage	prepared platform
EM2065	9	obsidian	(1.37)	(2.04)	0.29	---	random	uniface	flake fragment

Key: L = length W = width
T = thickness S/NW = stem/neck width
Measurements in parentheses denotes broken specimens



Late Paleo-Indian and Early Archaic period hafted bifaces from the Emery Tract.

A: 42EM1992-1, Lake Mohave
B: 42EM1988-1, Lake Mohave
C: 42EM2024-1, Lake Mohave
D: 42EM2043-1, Lake Mohave
E: EMIF-427-2, Lovell Constricted
F: 42EM1988-2, Plano tradition midsection
G: EMIF-67-2, Plano tradition midsection
H: 42EM2032-1, Plano tradition midsection
I: EMIF-385-8, Humboldt Concave-base A
J: 42SV474-4, Black Rock Concave Base
K: EMIF-45-3, Pinto Shoulderless
L: 42SV474-2, Pinto Shoulderless
M: 42EM2019-6, Pinto Shouldered
N: 42EM1993-2, Pinto Shouldered
O: 42SV2045-1, Northern Side-Notched
P: 42EM2011-1, Sudden Side-Notched
Q: 42EM2022-1, Hawken Side-Notched
R: EMIF-132-1, Hawken Side-Notched
S: 42EM2024-2, Duncan
T: 42SV2062-1, Duncan

FIGURE 13

Max. Dimensions (cm): length = 3.87-6.37 range, 5.53 avg.; width = 2.30-2.76 range, 2.50 avg.; thickness = 0.56-0.88 range, 0.71 avg.; stem width = 1.27-1.74 range, 1.54 avg.

Flaking Pattern: collateral

Function and Suggested Age: projectile point; 11,000-6,000 BP

These large stemmed points are reminiscent of Hell Gap points from the Plains, and of Early Archaic types like Jay and Rio Grande forms from the Southwest. Belonging to the Great Basin Stemmed tradition (Carlson 1983), the Castle Valley specimens differ from the types mentioned above in being more crudely flaked than Hell Gap points and having more pronounced shoulders than Southwestern forms. Also comparable are Silver Lake points which, as described by Holmer (1980:70, 76), match the project specimens fairly closely but more commonly have markedly rounded bases and stem edges resulting in a notched appearance (see Amsden 1937:82). Lake Mojave points are illustrated by Amsden (1937:81), Heizer and Hester (1978:35), Holmer (1978:48) and Carlson (1983:78). Few data from stratigraphic contexts are available; the style is thought to be of Paleo-Indian age (see Tipps et al. 1984:99, for example), but an Early Archaic (i.e., Black Knoll phase) age assignment cannot be ruled out.

Type: Lovell Constricted (?)

No. of Specimens: 1

Provenience: EMIF-427-2

Illustration: Figure 13

Material Type: chert

Max. Dimensions (cm): length = 6.46; width = 2.58; thickness = 0.84; stem width = 1.88

Flaking Pattern: parallel-transverse

Function and Suggested Age: projectile point; 9,000-7,000 BP

In its outward appearance this point resembles the previously described Lake Mojave-Silver Lake series, but distinctions are apparent. This isolated find has well-executed parallel-transverse (almost oblique) flaking with definite shoulders and moderately ground stem edges. It differs from the Lake Mojave and Pinto Shoulderless styles in being more finely flaked with more abrupt shoulders; it contrasts with Humboldt points in having a definite stem and thicker cross-section. Closest

comparisions are with the Lovell Constricted-Pryor Stemmed series, a late Paleo-Indian montane complex defined in the Middle Rocky Mountain foothills of the Montana-Wyoming area that dates to ca. 8,300-7,800 BP (e.g., Husted 1969; Frison 1978). While the Castle Valley specimen may be no more than a well-made Lake Mojave point, it does likely date to the late Paleo-Indian period or no later than the first subphase of the Black Knoll phase in the Early Archaic period.

Type: unknown late Paleo-Indian
No. of Specimens: 3
Provenience: 42EM1988, 2032 and EMIF-67-2
Illustration: Figure 13
Material Types: chert (67%), chalcedony (33%)
Max. Dimensions (cm): length = unknown; width = 2.28-2.32 range, 2.30 avg.; thickness = 0.46-0.65 range, 0.58 avg.
Flaking Pattern: parallel-oblique
Function and Suggested Age: projectile point; 8,500-7,500 BP

These three point fragments are large blade midsections, two of which are made from an identical material type (gray oolitic chert; see Copeland and Webster 1983:57). They are distinguished from Early Archaic forms like Humboldt on the basis of their greater width and thick, almost diamond-shaped cross-section. Several parallel-oblique flaked styles of the Plano tradition are known from the Northwestern Plains (e.g., the Lovell Constricted-Pryor Stemmed, Frederick, Lusk and James Allen types), with which these specimens best compare (Frison 1978:34-40).

Type: Humboldt Concave-Base A
No. of Specimens: 1
Provenience: EMIF-385-8
Illustration: Figure 13
Material Types: chalcedony
Max. Dimensions (cm): length = 4.74; width = 2.03; thickness = 0.36
Flaking Pattern: parallel-oblique
Function and Suggested Age: projectile point; 7,600-6,100 BP

The single Humboldt point in the collection is a complete specimen of orange chalcedony with a thin lenticular cross-section, finely serrated

blade edges, and unground basal edges. This Early Archaic period style differs from similarly flaked Paleo-Indian forms in being thinner without basal edge grinding, and from McKean lanceolate points in having parallel-oblique rather than collateral flaking. Comparable specimens are illustrated by Hester and Heizer (1978:27) and Holmer (1978:44-45). Thomas (1983:187-189) notes that the Humboldt points from Gatecliff Shelter post-date 5,000 BP (and are, therefore, contemporaneous with McKean lanceolate points), but data from the northern Colorado Plateau indicate the style is diagnostic of the late subphase of the Black Knoll phase in this area.

Type: Black Rock Concave Base
No. of Specimens: 1
Provenience: 42SV474
Illustration: Figure 13
Material Types: chalcedony
Max. Dimensions (cm): length = 4.63 (broken); width = 1.72 (broken); thickness = 0.63
Flaking Pattern: collateral
Function and Suggested Age: projectile point; 8,000-3,000 BP

The single specimen of this type was recovered from a multicomponent habitation near the head of Willow Springs Wash, a site first recorded in the early 1970s (Berry 1974). Though broken longitudinally, the point compares well with those illustrated by Heizer and Hester (1978:Figure 7i-k). Its overall large size, particularly its width and thickness, and the somewhat crude flaking distinguish this type from similar lanceolate forms like the Humboldt series and certain Plains types. At Gatecliff Shelter, concave base points similar to that from 42SV474 are called Triple T Concave Base and date to 5,400-5,150 BP (Thomas 1983:189, 193). At Hogup Cave, they occur as early as 7,800 BP but are most common in Stratum 8 dating to 4,600-3,200 BP (Aikens 1970:29, 34, 43; cf. Madsen and Berry 1975). These data suggest an Early-Middle Archaic date for the style, i.e. in the Black Knoll, Castle Valley and Green River phases of Schroedl (1976).

Type: Pinto Shoulderless
No. of Specimens: 2

Provenience: 42SV474, EMIF-45-3
Illustration: Figure 13
Material Types: chert
Max. Dimensions (cm): length = unknown; width = 1.35; thickness = 0.45-0.51 range, 0.48 avg.
Flaking Pattern: collateral
Function and Suggested Age: projectile point; 8,300-6,200 BP

Two base fragments, both lacking ground edges, are included in this type. One specimen has a notched/indented base with rounded corners, similar to Humboldt specimens depicted by Heizer and Hester (1978:27) and to a McKean lanceolate point illustrated by Holmer (1978:Fig. 13d). The second item has sharply pointed basal corners and a concave base. Holmer (1978:44, 67) stresses the observation made by others that the Humboldt and Pinto types may be related, but distinguishes the types by flaking pattern. Though both the Pinto Shoulderless and McKean lanceolate types have collateral flaking, the latter is more finely-executed and base corners are not rounded--the specimen shown in Holmer (1978:Fig. 23d) is probably not a McKean lanceolate point, regardless of the statistics. Pinto points date to the Black Knoll phase on the northern Colorado Plateau.

Type: Pinto Shouldered
No. of Specimens: 2
Provenience: 42EM1993, 42EM2019
Illustration: Figure 13
Material Types: chert (50%), chalcedony (50%)
Max. Dimensions (cm): length = unknown; width = 1.71-2.78 range, 2.25 avg.; thickness = 0.59-0.68 range, 0.64 avg; stem width = 1.28-1.64 range, 1.46 avg.
Flaking Pattern: collateral
Function and Suggested Age: projectile point; 8,300-6,200 BP

These two projectiles are similar to the shoulderless variety in having collateral flaking, but stem morphology varies widely. One specimen shows pronounced, abrupt shoulders (unfortunately, the basal edge is broken) while the other point of this type has sloping shoulders and a much narrower blade. Comparable specimens are illustrated by Holmer (1978:43, 1980:69), Heizer and Hester (1978:29) and Thomas (1983:192).

The latter references this style as Gatecliff Split-Stem diagnostic of the period 5,000-3,300 BP (again, contemporaneous with McKean complex Duncan-Hanna points of the Plains) but, as noted above, Pinto points date to the earlier Black Knoll phase in this area.

Type: Northern Side-Notched
No. of Specimens: 1
Provenience: 42SV2045
Illustration: Figure 13
Material Types: chert
Max. Dimensions (cm): length = unknown; width = 2.35; thickness = 0.34; neck width = 1.35
Flaking Pattern: unknown
Function and Suggested Age: projectile point; 6,900-6,300 BP

One specimen of this type has a wide concave base and notches low on the lateral margins, but the blade is broken away. Side-notched dart points are widespread during the Early Archaic period, with local type names abounding (e.g. Oxbow, Bitterroot, Pahaska, Rocker, Sudden, Hawken, etc.). However, the Castle Valley area appears to be on the southwestern fringe of this distribution, since Early Archaic side-notched forms are absent in the central-southern Great Basin and Southwest (Irwin-Williams 1973, 1979; Holmer 1978; Thomas 1983). The Northern Side-Notched type differs from Hawken points in its greater width and concave base; from Sudden Side-Notched points in its thinner cross-section and side notches set closer to the base; and from Rocker Side-Notched in having a concave rather than convex base (the Oxbow-Pahaska series is quite similar, but these names apply to Northern Plains points; cf. Tipps et al. 1984:103). This style dates to the late subphase of the Black Knoll phase on the northern Colorado Plateau.

Type: Hawken Site-Notched
No. of Specimens: 2
Provenience: 42EM2022, EMIF-132-1
Illustration: Figure 13
Material Types: chert (50%), chalcedony (50%)

Max. Dimensions (cm): length = 4.00; width = 1.71-2.08 range, 1.90 avg.; thickness = 0.43-0.52 range, 0.48 avg.; neck width = 1.34-1.37 range, 1.36 avg.

Flaking Pattern: collateral (50%), parallel-oblique (50%)

Function and Suggested Age: knife (50%), projectile point (50%); 6,500-4,600 BP

These two side-notched artifacts differ fron the Northern type just described in their straight to slightly convex rather then concave base shapes, and in being somewhat narrower in outline. However, as defined by Holmer (1978:49, 51), the Hawken type encompasses much more variation than is found at the type site on the Northwestern Plains. In fact, there is little use of the "Hawken" point name on the Plains (Frison 1978:40-46, 83). Instead, names such as Blackwater, Pahaska, Bitterroot and Oxbow are used to deal with the range in variation in blade and haft element morphology. For instance, specimen 42EM2022-1 resembles Blackwater Side-Notched with its wide convex base and almost corner-notched appearance (cf. Rocker Side-Notched of Holmer [1978:54-55] and Mt. Albion Corner-Notched of Benedict and Olson [1978:101-104]), whereas isolate EMIF-132-1 conforms more to the Pahaska-Bitterroot-Hawken series with its low, small side-notches above a straight base. Whether one follows the "splitter" approach of Plains researchers or the "lumper" approacher of Holmer (1978), all such large side-notched forms date to the Early Archaic with the "Hawken" style prevalent during the late subphase of the Black Knoll phase, continuing throughout the subsequent Castle Valley phase (Schroedl 1976).

Type: Sudden Side-Notched

No. of Specimens: 1

Provenience: 42EM2011

Illustration: Figure 13

Material Types: chalcedony

Max. Dimensions (cm): length = unknown; width = 2.86; thickness = 0.68; neck width = 1.94

Flaking Pattern: collateral

Function and Suggested Age: projectile point; 6,400-4,700 BP

The single specimen of this type was recovered from a medium diversity chipping station on a high mesa rim overlooking Willow Springs Wash. It has large notches set high on the lateral margins, a thick biconvex cross-section and apparently straight base (the latter is mostly broken away). This type is similar to the Mallory style found on the Plains (Forbis et al. n.d.; Lobdell 1973, 1974; Frison et al. 1974:121-122), the latter unfortunately renamed San Rafael Side-Notched by Holmer (1978:49, 53). However, it contrasts with the Mallory type in being a bulkier form with a straight to slightly convex rather than concave or notched base. Sudden Side-Notched points were defined at Sudden Shelter (Holmer 1980:76) where they date to the Castle Valley phase, and have been found as far away as northern New Mexico (Alexander and Reiter 1935:Plate VIIt).

Type: Duncan
No. of Specimens: 2
Provenience: 42EM2024, 42SV2062
Illustration: Figure 13
Material Types: chert (50%), chalcedony (50%)
Max. Dimensions (cm): length = 3.28; width = 1.80; thickness = 0.41-0.52 range, 0.46 avg.; stem width = 1.29-1.37 range, 1.33 avg.
Flaking Pattern: parallel-transverse
Function and Suggested Age: projectile point; 4,500-3,000 BP

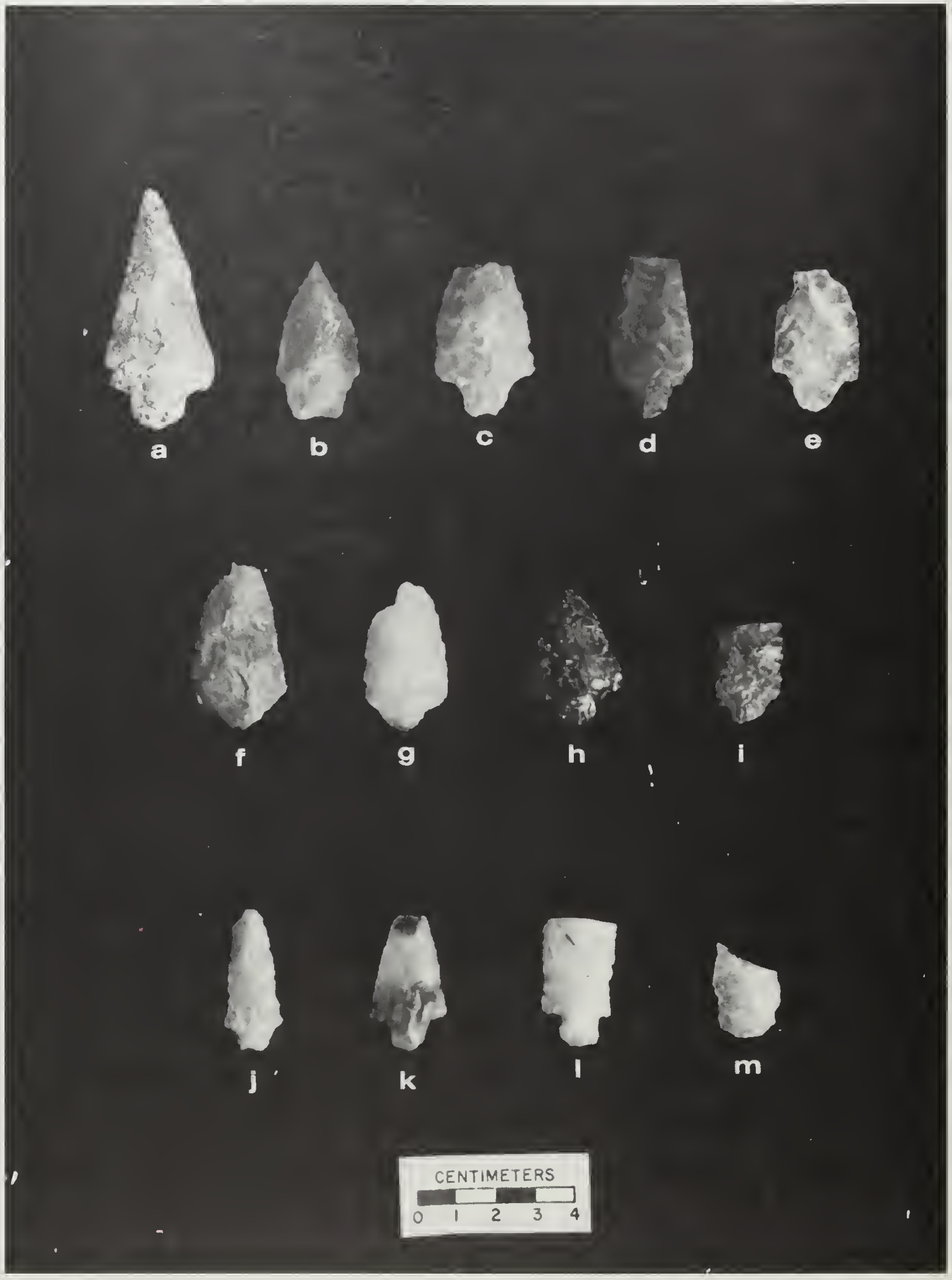
These two points, particularly specimens 42EM2024-2, are stemmed indented base points with almost straight stem edges and finely executed flaking. Of the Basin-Plateau types defined by Holmer (1978), only the Pinto Shouldered/Gatecliff Split Stem type is comparable. However, the project artifacts differ from the Pinto series in being more finely flaked with a more lenticular cross-section. Closest comparisons are with the Duncan-Hanna series of the widespread McKean complex (Mulloy 1954; Wheeler 1954; Frison 1978:46-50); they are assigned to the Duncan type based on the sloping shoulders and nearly parallel stem edges (Hanna points have abrupt shoulders and expanding stems). Schroedl (1976:65-68) notes that Duncan-Hanna points are stratigraphically above similar Pinto points at Deluge Shelter (see Leach 1970:48-55), but discounts a genetic relationship between the two styles (cf. Green 1975). At that site the Pinto points combine Duncan and Hanna morphology with their abrupt shoulders and

parallel stem edges (often ground), while the later McKean complex points conform more to the Hanna type description noted above. The two Duncan points from the project area are thus assigned to the Green River phase, especially its early subphase dating to 4,500-3,800 BP.

Type: Summit Stemmed
No. of Specimens: 2
Provenience: 42EM2044; EMIF-274-3
Illustration: Figure 14
Material Types: chalcedony
Max. Dimensions (cm): length = unknown; width = 1.87; thickness = 0.48-0.54 range, 0.51 avg.; stem width = 0.96-1.41 range; 1.18 avg.
Flaking Pattern: collateral
Function and Suggested Age: projectile point; 4,500-3,000 BP

These points are of a style not recognized in the Basin-Plateau or Plains areas, and were named by Gooding (1981:27-29) from excavations at the high altitude Vail Pass Site in Colorado even though a definite age assignment could not be made. Irwin and Irwin (1959:23), Buckles (1971: Figure 4c), Black et al. (1982:102) and Black (1983:18) illustrate similar lanceolate points with abrupt shoulders and square stems, many of which were found in association with McKean complex point types (Duncan, Hanna and Mallory). Others feel that square stemmed points are Gypsum variants, but either interpretation places the type in the Middle Archaic time frame. Holmer (1980:77) describes a square-stemmed point type, "Unnamed Type 1", from Sudden Shelter that differs from the project specimens only in having sloping shoulders, but also dates to the Middle Archaic. Thus, the Summit Stemmed type is assigned to the Green River phase based on these data.

Type: Gypsum
No. of Specimens: 11
Provenience: 42EM1933, 1996, 2006, 2019, 2047 and 2063; 42SV2033 and 2048; EMIF-43-4, 274-2 and 385-2.
Illustration: Figure 14
Material Types: chalcedony (55%), chert (45%)
Max. Dimensions (cm): length = 3.42-6.14 range, 4.53 avg.; width =



Gypsum and Summit Stemmed points of the Middle–Late Archaic periods.

A: 42EM2047-1, Gypsum
B: 42EM1996-1, Gypsum
C: 42EM2019-1, Gypsum
D: EMIF-385-2, Gypsum
E: 42EM1993-1, Gypsum
F: EMIF-43-4, Gypsum
G: EMIF-274-2, Gypsum
H: 42SV2033-1, Gypsum
I: 42SV2048-1, Gypsum
J: 42EM2063-1, Gypsum
K: 42EM2006-1, Gypsum
L: 42EM2044-1, Summit Stemmed
M: EMIF-274-3, Summit Stemmed

FIGURE 14

1.47-2.75 range, 2.16 avg.; thickness = 0.39-0.75 range, 0.57 avg.; stem width = 0.96-1.56 range, 1.20 avg.

Flaking Pattern: collateral (91%), chevron (9%)

Function and Suggested Age: projectile point (82%), knife (9%), scraper (9%); 4,600-1,500 BP

Apart from the Elko series, this is the most common point type found in the study area. Gypsum points show a wide variation in blade shape, ranging from lanceolate to triangular, and are characterized by short, contracting stems and abrupt, sometimes rounded or oblique shoulders. Thomas (1983:183-184, 192-193) renames these points "Gatecliff Contracting Stem" based on data from Gatecliff Shelter where they date to 3,400-3,250 BP, but the Gypsum type name is well-established in the literature and is retained here (see Holmer 1978:49-50). This style is more widespread than is sometimes assumed, with typical specimens found as far east as the Southern Rocky Mountains (Stewart 1970; Gooding 1981) and their eastern foothills (Irwin and Irwin 1959; Lewis and Radford 1982), and as far south as Bat Cave, New Mexico (Dick 1959:Figure 221). However, they are generally absent from the Northwestern Plains of Wyoming, including the Green River Basin. Gypsum points date to the Green River and Dirty Devil phases of Schroedl (1976), and are particularly diagnostic of the Green River late subphase dating to 3,800-3,300 BP (ibid.; Holmer 1980).

Type: Elko Eared

No. of Specimens: 1

Provenience: 42EM2070

Illustration: Figure 15

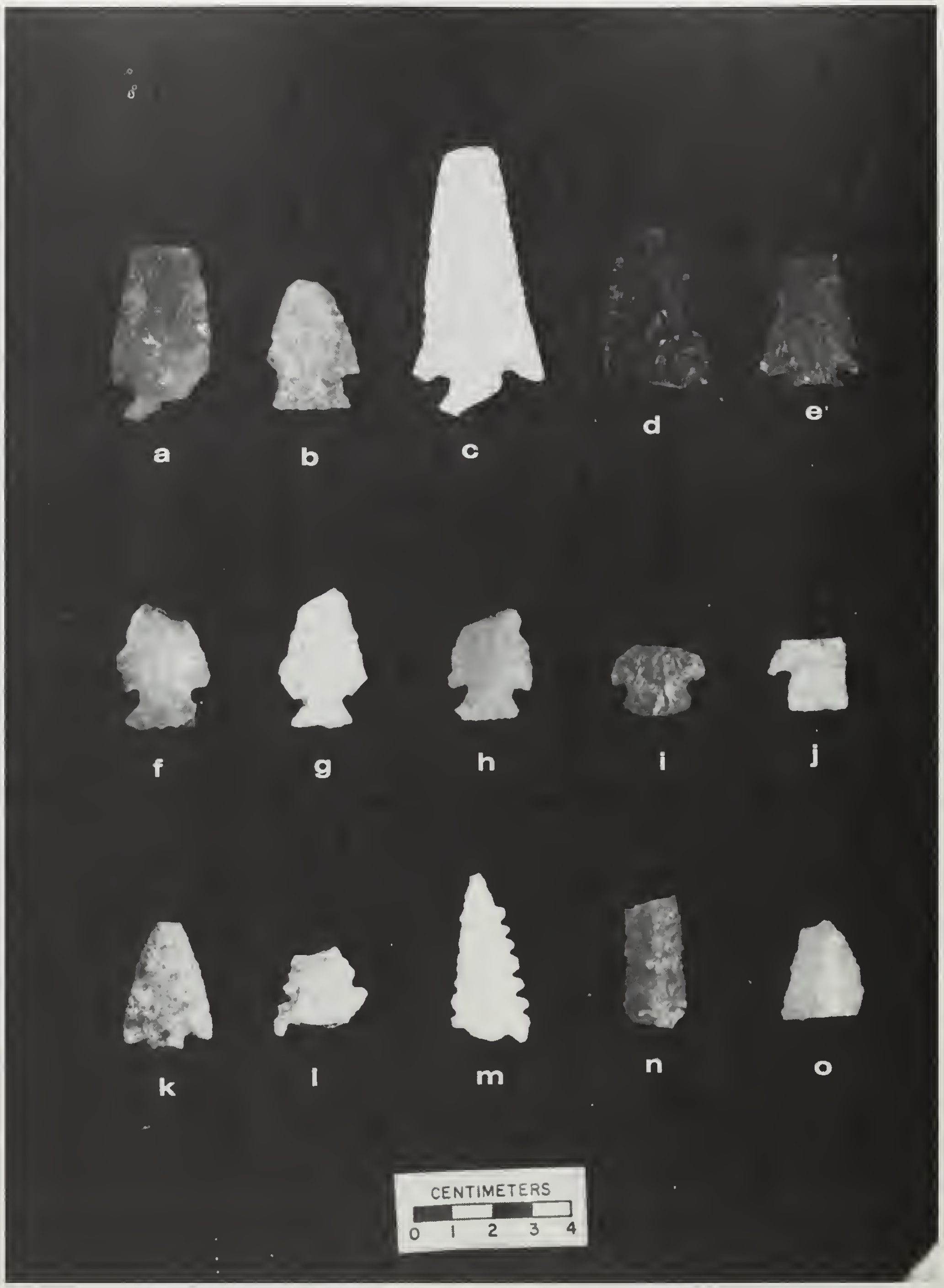
Material Type: chert

Max. Dimensions (cm): length = unknown; width = 2.52; thickness = 0.59; neck width = 1.41

Flaking Pattern: collateral

Function and Suggested Age: projectile point; 7,600-3,800 BP

The single Elko Eared point found in the project area, from a short-term camp in the Scattered Small Tracts, conforms to the type description of Holmer (1978:38) except the stem is not quite as wide as the blade. At Gatecliff Shelter (Thomas 1983:183, 187-191), Elko Eared points were found in abundance in four strata dating between 3,250 and 1,250 BP. Holmer



Elko series points and serrated specimens from all three study tracts.

A: 42EM2070-1, Elko Eared
B: 42SV439-1, Elko Side-Notched
C: EMIF-251-2, Elko Corner-Notched
D: 42EM2069-1, Elko Corner-Notched
E: 42SV2060-1, Elko Corner-Notched
F: 42EM2044-3, Elko Corner-Notched
G: 42EM2019-2, Elko Corner-Notched
H: 42SV474-5, Elko Corner-Notched
I: 42EM2047-2, Elko Corner-Notched
J: 42EM1256-2, cf. San Rafael Stemmed
K: 42EM1995-1, Elko Corner-Notched
L: 42EM2019-5, four notches, graver(?) spur
M: 42EM2024-3, serrated Elko
N: 42EM2010-1, Archaic period fragment
O: ELIF-50-1, Archaic period fragment

FIGURE 15

(1978:62-65), on the other hand, dates the style earlier than 3,800 BP in the Basin-Plateau region, and repeats the suggestion made by others (e.g., Hester 1973) that the Elko series occurs in earlier contexts in the eastern [and northern] Great Basin than in the southern, central and western Great Basin. No Elko Eared points were found at Sudden Shelter (Holmer 1980:67), therefore Holmer's (1978) assignment of a 7,600-3,800 BP date range for the style is retained here on present evidence.

Type: Elko Side-Notched
No. of Specimens: 2
Provenience: 42EM2044, 42SV439
Illustration: Figure 15
Material Types: chert (50%), chalcedony (50%)
Max. Dimensions (cm): length = 3.32; width = 2.34-2.36 range, 2.35 avg.; thickness = 0.47-0.58 range, 0.52 avg.; neck width = 1.29-1.65 range, 1.47 avg.
Flaking Pattern: collateral
Function and Suggested Age: projectile point (50%), knife (50%); post-7,600 BP

Two points in the collected project assemblage conform to the type description for Elko Side-Notched (Holmer 1978:38), with expanding stem edges that are as wide as the maximum blade width. That one of the points in our collection was used as a knife should come as no surprise, since others have noted a similar function for Elko series "points" (e.g., Fowler et al. 1973:41; Wylie 1975). At Sudden Shelter (Holmer 1980), Elko Side-Notched points occur no later than ca. 4,000 BP and are most common in Stratum 7 dating to ca. 6,500-6,300 BP. Thus, even though the style is considered undiagnostic in the Castle Valley area, a general Archaic age assignment is tentatively made here--particularly for Elko specimens with demonstrable evidence of use as dart points (i.e., those exhibiting impact-fractured tips; cf. Black et al. 1984:111-112).

Type: Elko Corner-Notched
No. of Specimens: 11
Provenience: 42EM1256 (2), 1987, 1995, 2019, 2047 and 2069; 42SV474 and 2060; ELIF-41-1 and EMIF-251-2

Illustration: Figure 15

Material Types: chert (55%), chalcedony (27%), quartzite (9%), siltstone (9%)

Max. Dimensions (cm): length = unknown; width = 2.13-3.32 range, 2.48 avg.; thickness = 0.40-0.62 range; 0.50 avg; neck width = 0.96-1.71 range, 1.24 avg.

Flaking Pattern: collateral

Function and Suggested Age: projectile point (55%), knife (18%), scraper (9%), unknown (9%); post-7,600 BP

Along with Gypsum points, this is the most common style represented in our collection, albeit it is also the most variable. The type is best described as a large corner-notched point with an irregularly-flaked triangular blade; haft element morphology, other than the general feature of corner notches, varies so much that it is essentially unimportant/ignored in Holmer's (1978:35-37) typology. The generally crude flaking and variable haft element morphology of Elko points contrast with other corner-notched types such as Pelican Lake, the latter characterized by finely-flaked blades with sharp shoulders and thin, often ground bases. On the other hand, the two Elko points from 42EM1256 would be classified as "San Rafael Stemmed" by Tipps et al. (1984:104-105) based on statistical analysis of surface specimens. Thus, whether or not distinctive, temporally diagnostic corner-notched forms are lumped together under the Elko name is an open question. Holmer (1978:62-65) notes three flourits in the occurrence of Elko Corner-Notched points: 7,600-6,200 BP, 5,000-3,400 BP and 1,800-1,000 BP.

Significantly, the style is not found in pre-4,000 BP contexts in the central or southern Great Basin (e.g., Thomas 1983:181-182), on the Northwestern Plains (Frison 1978) or in the Southwest (Irwin-Williams 1973, 1979). Earlier occurrences of the style appear spatially restricted to the northern and eastern Great Basin, northern Colorado Plateau (including the project area; Holmer 1978, 1980) and Middle Rocky Mountains (e.g., Mummy Cave, Wyoming; Frison 1978:45-46). Black et al. (1984:111-112) hypothesized that medium-sized Elko points might be Late Archaic period (Dirty Devil phase) diagnostics in those Basin-Plateau areas immediately adjacent to the Northwestern Plains and Southwest, where similar Pelican Lake and Basketmaker II point styles are prevalent at that

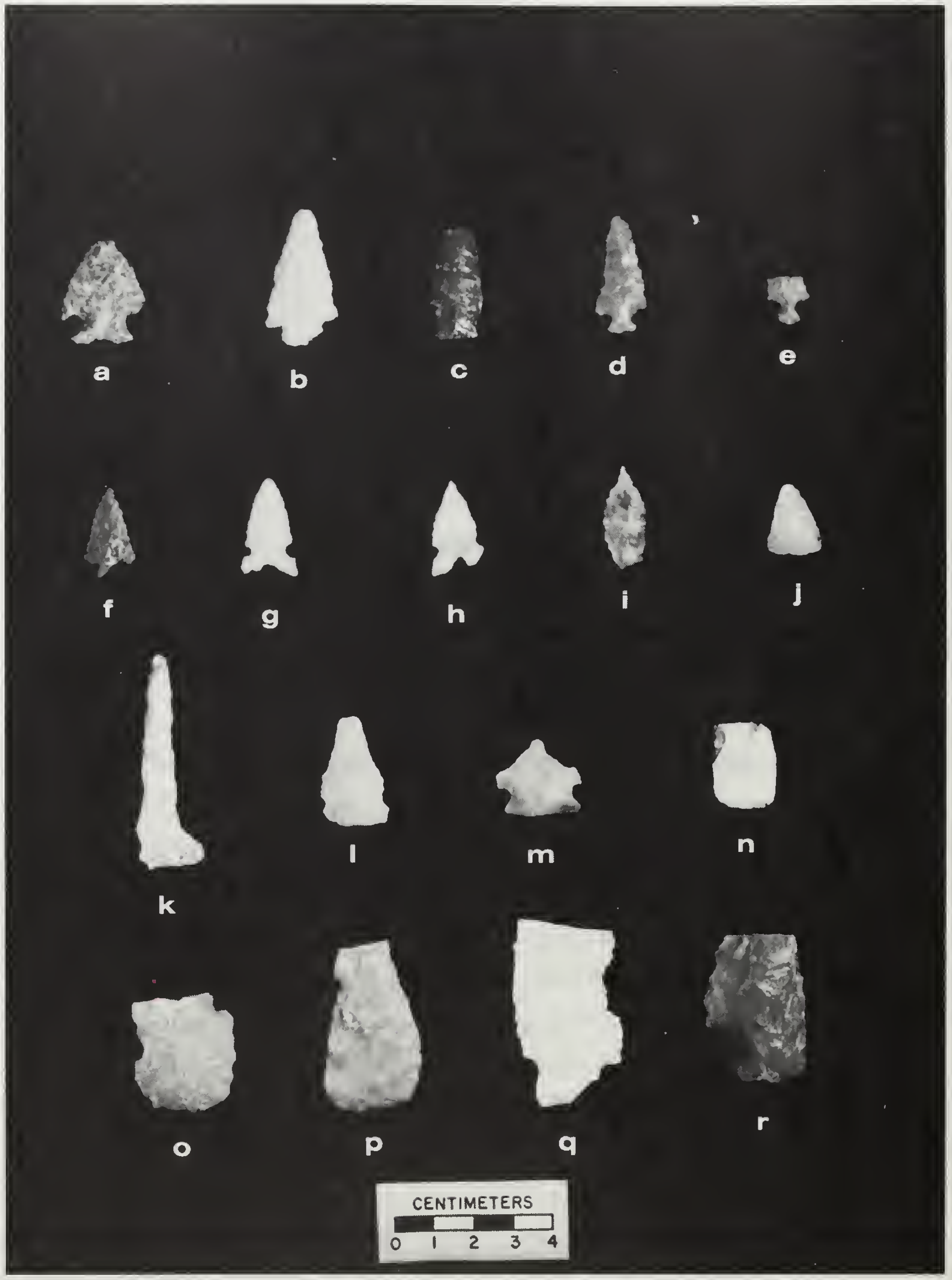
time. However, the evidence from Sudden Shelter (Holmer 1980) seems clear-cut in terms of project area prehistory. Thus, as with the Elko Side-Notched style, only a general Archaic period age is assigned to this type--again, applied mainly to those specimens used as projectiles rather than as knives or scrapers.

Type: unnamed Archaic period fragments
No. of Specimens: 4
Provenience: 42EM2010, 2019 and 2024; ELIF-50-1
Illustration: Figure 15
Material Types: chalcedony (75%), chert (25%)
Max. Dimensions (cm): length and width = unknown; thickness = 0.37-0.53 range, 0.45 avg.; neck width = 0.82-1.63 range, 1.22 avg.
Flaking Pattern: collateral
Function and Suggested Age: projectile point (50%), graver? (25%); saw? (25%); 8,000-1,500 BP

These are large blade fragments of a size suggestive of dart points pre-dating introduction of the bow-and-arrow around 1,800-1,500 BP. Two specimens are deeply serrated--one has at least three hafting notches--and may be corner-notched (Elko?). Two others are dart point fragments with lanceolate to triangular outlines. While one might speculate on the function(s) of the serrated items, further discussion of chronological implications seems unwarranted.

Type: unnamed, small corner-notched
No. of Specimens: 2
Provenience: 42EM1993, ELIF-1-1
Illustration: Figure 16
Material Types: chert
Max. Dimensions (cm): length = 2.92; width = 1.82-2.18 range, 2.0 avg.; thickness = 0.40-0.45 range, 0.42 avg.; neck width = 1.01-1.09 range, 1.05 avg.
Flaking Pattern: collateral
Function and Suggested Age: arrow point, AD 250-1000

This type is identical to the Elko Corner-Notched style, except the size measurements suggest use as arrow tips rather than as spear tips (see



Late Prehistoric period arrow points and other chipped stone tools.

A: 42EM1993-3, unnamed corner-notched
B: ELIF-1-1, unnamed corner-notched
C: SST-IF-1, cf. Sinbad Side-Notched
D: 42EM2068-6, Rose Spring Corner-Notched
E: 42SV474-1, Rose Spring Corner-Notched
F: 42EM2053-1, Rose Spring
G: EMIF-67-3, Desert Side-Notched
H: 42EM1079-1, Desert Side-Notched
I: 42SV2034-1, Cottonwood Triangular
J: 42EM2065-6, Cottonwood Triangular
K: 42EM2019-3, drill
L: 42EM2026-2, drill: reworked side-notched point
M: 42EM2026-1, drill: reworked side-notched point
N: 42EM2065-13, biface
O: 42EM2066-3, biface
P: SST-IF-I, biface
Q: 42EM2006-2, scraper: reworked Scottsbluff point?
R: 42EM2019-4, hafted scraper

FIGURE 16

Thomas 1978). The two points in our collection differ from Rose Spring points in having wider necks and wide, expanding stem edges. They are common on the Northwestern Plains and northern Colorado Plateau, but are often included in the Rose Spring series (see Lindsay and Lund 1976; Copeland and Webster 1983:63). On the other hand, limited data suggest that this style is of early Late Prehistoric period age, i.e., contemporaneous with Rose Spring points (e.g., Metcalf 1983).

Type: Rose Spring Corner-Notched
No. of Specimens: 3
Provenience: 42EM2053 and 2068, 42SV474
Illustration: Figure 16
Material Types: chert (33%), chalcedony (33%), quartzite (33%)
Max. Dimensions (cm): length = 2.29; width = 1.06-1.32 range, 1.23 avg.; thickness = 0.25-0.41 range, 0.34 avg.; neck width = 0.37-0.55 range, 0.48 avg.
Flaking Pattern: collateral (50%), chevron (50%)
Function and Suggested Age: arrow point; AD 250-950

These three points are small corner-notched artifacts with long, slender triangular blades and small, bulbous stems. They differ from the preceeding corner-notched type in having a narrower overall outline and much smaller stem (cf. Lindsay and Lund 1976:44). This style is common in early Fremont contexts and is the earliest-occurring arrow point in the region. Webster (1980:65) notes that Rose Spring points occur in strata at Dry Creek Rockshelter, Idaho dated as early as 3,300 BP and "appear to have been well established by level 10, estimated to date between 2400 and 1950 BP." Holmer and Weder (1980:56-60), based on data from Cowboy Cave (Jennings 1980), place the introduction of Rose Spring points and the bow-and-arrow on the northern Colorado Plateau at AD 250-300. Given the trend for certain point styles to occur earlier in the northern Great Basin and Basin-Plateau region (e.g., the Pinto and Elko series) than in surrounding areas, and considering the data from southern Idaho, the earliest use of Rose Spring points in the Castle Valley area may pre-date AD 250.

Type: Sinbad Side-Notched
No. of Specimens: 1

Provenience: SST-IF-1
Illustration: Figure 16
Material Types: chert
Max. Dimensions (cm): length = unknown; width = 1.35; thickness = 0.51; neck width = 1.00
Flaking Pattern: parallel-transverse
Function and Suggested Age: arrow point; AD 700-1200

This enigmatic point style was named by Tipps et al. (1984) based on survey data from the San Rafael Swell area. The project specimen is a small and narrow point with finely-executed flaking, thick biconvex cross-section and proximally constricted lateral margins giving the appearance of broad, shallow side notches. Although Tipps et al. (1984:99) consider the style to be Early Archaic in age, the small size of our specimen is much more suggestive of a post-Archaic arrow point (see Thomas 1978). None of the side-notched forms described by Holmer and Weder (1980) match this style; we tentatively ascribe the point to the local Fremont occupation, but excavation data are needed.

Type: Desert Side-Notched
No. of Specimens: 2
Provenience: 42EM2079, EMIF-67-3
Illustration: Figure 16
Material Types: chalcedony
Max. Dimensions (cm): length = 2.2-2.5 range, 2.35 avg.,; width = 1.34-1.42 range, 1.38 avg.; thickness = 0.29-0.32 range, 0.3 avg.; neck width = 0.87-0.97 range, 0.92 avg.
Flaking Pattern: chevron
Function and Suggested Age: arrow point, AD 1150-1880

This style is considered evidence of the arrival of Numic speaking populations in Utah (Holmer and Weder 1980:60; Madsen 1975b; Bettinger and Baumhoff 1982). In the Castle Valley area, ethnographic evidence indicates that the Yampah and "Seuvarits" bands of Ute Indians were present, but conflicting data confuse the issue (see summary by Janetski [1982:22-24]). The Desert Side-Notched style, with its distinctive basal notch and/or concavity, occurs over a wide area of the West and under a variety of names (e.g., Kehoe 1966; Gleichman 1984). However, the

association of such points with "Shoshonean" ceramics at many sites on the northern Colorado Plateau supports the interpretation of Holmer and Weder (1980) that they represent Ute occupation in this region.

Type: Cottonwood Triangular
No. of Specimens: 2
Provenience: 42EM2065, 42SV2034
Illustration: Figure 16
Material Types: chert (50%), chalcedony (50%)
Max. Dimensions (cm): length = 1.76-2.59 range, 2.18 avg.; width = 1.10-1.36 range, 1.23 avg.; thickness = 0.31-0.38 range, 0.34 avg.
Flaking Pattern: collateral (50%), random (50%)
Function and Suggested Age: arrow point blank(?); AD 900-1880

This triangular form is commonly considered to represent blanks or preforms for arrow points, generally due to the lack of evidence to the contrary. The two project specimens likewise exhibit a lack of use-edge wear, and both occur at multiple activity sites with probable Fremont components (Miller n.d.). This suggests a beginning date of ca. AD 700 or so, but the earliest date reported for the style is ca. AD 900 at Conway Shelter (Heizer and Hester 1978:11-12).

Type: unnamed Late Prehistoric period fragments
No. of Specimens: 6
Provenience: 42EM1996, 2016 and 2066; 42SV2046; ELIF-27-2 and 147-1
Illustration: none
Material Types: chert (50%), chalcedony (33%), quartzite (17%)
Max. Dimensions (cm): length = unknown; width = 1.32-1.75 range, 1.54 avg.; thickness = 0.27-0.44 range, 0.36 avg.
Flaking Pattern: chevron (50%), collateral (17%), random (17%), unknown (17%)
Function and Suggested Age: arrow point; AD 250-1880

These fragments are small blade portions of a size suggesting use as arrow tips (Thomas 1978), and therefore are of post-Archaic age. They are distinctive only in the variety of flaking patterns and material types represented, which might indicate that several point styles are included in this category.

Type: Hafted scraper

No. of Specimens: 2

Provenience: 42EM2006 and 2019

Illustration: Figure 16

Material Types: chert (50%), chalcedony (50%),

Max. Dimensions (cm): length = unknown; width = 2.56-2.65 range, 2.6 avg.; thickness = 0.74-0.81 range, 0.78 avg.; stem width = 1.58-1.71 range, 1.64 avg.

Flaking Pattern: parallel-transverse (50%), collateral (50%)

Function: scraper

These two artifacts are large, bifacially flaked items with plano-convex cross-sections and one beveled lateral edge. Each is stemmed--specimen 42EM2019-4 is single shouldered--and each bears a superficial resemblance to late Paleo-Indian Cody complex tools. Specimen 42EM2006-2 in particular has the outward appearance of a Scottsbluff point and may, in fact, be a reworked version of that style. Cody complex artifacts are perhaps the most commonly encountered Paleo-Indian manifestations in Utah along with the Lake Mojave series (e.g., Black <u>et al</u>. 1984; Copeland and Webster 1983), but the hafted scrapers from the Emery Tract provide only a suggestion of Cody occupation in the project area.

Type: Hafted drill

No. of Specimens: 4

Provenience: 42EM2019 and 2026 (3)

Illustration: Figure 16

Material Types: chalcedony (75%), chert (25%)

Max. Dimensions (cm): length = 1.94-5.33 range, 3.33 avg.; width = 1.65-2.12 range, 1.88 avg.; thickness = 0.43-0.54 range, 0.48 avg.; neck/stem width = 1.13-1.54 range, 1.37 avg.

Flaking Pattern: random (50%), parallel-oblique (25%), collateral (25%)

Function: drill

These four artifacts include a formal drill with expanding base from 42EM2019, and three possible dart points with reworked blades from 42EM2026. Of the latter, two are side-notched and one has a stemmed, indented base; all three may be reworked Early Archaic points but the occupation of 42EM2026 doesn't necessarily relate to that period. Hogan

(1980:97) illustrates a variety of drills from Sudden Shelter, which were likely used as perforating tools on relatively soft material such as animal hides.

Type: unmodified biface
No. of Specimens: 3
Provenience: 42EM2065 and 2066; SST-IF-I
Illustration: Figure 16
Material Types: chert (67%), quartzite (33%)
Max. Dimensions (cm): length = unknown; width = 1.60-2.59 range, 2.23 avg.; thickness = 0.38-0.87 range, 0.60 avg.
Flaking Pattern: random (67%), collateral (33%)
Function: preform (67%), "knife" (33%)

These artifacts represent secondary and final stages of biface reduction, prior to final shaping to a patterned tool form. No obvious edge wear is present; the specimen from 42EM2065 differs from Cottonwood Triangular points in having a squared rather than triangular outline. Hauck and Weder (1982:19-23, 54) describe a three-stage biface reduction sequence, in which "blanks" are further refined to "preforms" which, in turn, are finely flaked to produce "knives". A fourth, smaller biface--the "biface pressure retouch flake"--is seen as an unrelated stage involving arrow point manufacture. Two of our specimens are preforms using this classification, and one (from 42EM2065) is a "knife" although no edge wear is apparent.

Type: obsidian
No. of Specimens: 2
Provenience: 42EM2045 and 2065
Illustration: none
Material Types: obsidian (100%)
Max. Dimensions (cm): length and width = unknown; thickness = 0.29-0.43 range, 0.36 avg.
Flaking Pattern: random
Function: uniface (50%), debitage (50%)

These two obsidian artifacts include a large interior flake fragment with a heavily ground platform, and a small uniface fragment with broken

edges. The former is translucent with no inclusions, while the latter is of a gray, nearly opaque obsidian. Nelson and Holmes (1979) performed trace element analysis on obsidian from 42EM625 and 42SV386 in the Castle Valley area, and identified the sources as the Mineral Mountains for the former and the Black Rock area for the latter. Both sources are the closest known to Castle Valley (Nelson and Holmes 1979:Fig. 5), and suggest a trade route to the west that may have followed Ivie Creek across the Wasatch Plateau.

The 78 collected lithic artifacts described above include 36 of chert (46%), 34 chalcedony (44%), five quartzite (6.5%), two obsidian (2.5%) and one siltstone (1%). With the exception of obsidian, all of these raw materials could be procured locally either from the widespread pediment gravels within and near the project area, or from bedrock exposures in the Cedar Mountain and Morrison formations east of the Coal Cliffs (e.g., Lindsay and Rauch 1982:7). The large number of quarry sites in the Emery and Scattered Small Tracts (23) is ample evidence of the abundance of knappable tool stone in Castle Valley. Projectile point data also provide a suggestion of occupation dates; of course, surface evidence from survey must be interpreted very conservatively until excavation data are available. This caveat notwithstanding, present data indicate that six sites and two IFs may be of Paleo-Indian age; 24 sites and ten IFs may have one or more Archaic components (including six with Elko series points); and ten sites and six IFs have lithic tools suggesting Late Prehistoric period (Fremont or Ute) occupation.

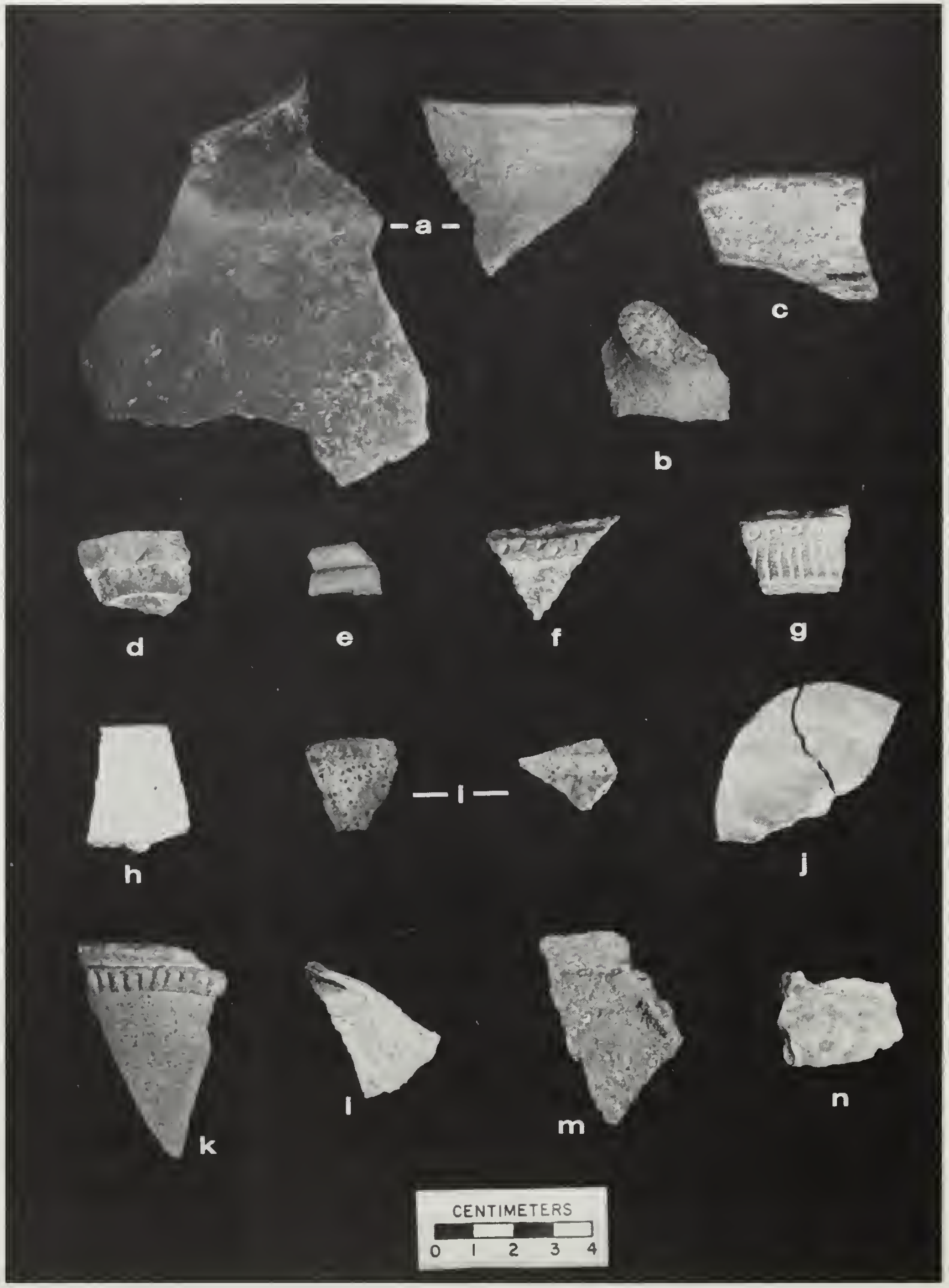
Ceramic sherds have been collected from 18 sites and four IFs, and were observed at nine other sites. Seven types are represented, most of which correspond to the descriptions provided by R. Madsen (1977). By far the most common ware observed in the Emery and Scattered Small Tracts was Emery Gray (no ceramics were found in the Elmo Tract), not an unexpected circumstance. Five sites yielded Emery Gray sherds with some form of exterior surface treatment such as a fugitive red wash, incising, appliqued decorations, etc. Sevier Gray was the second most common type encountered, while Ivie Creek Black-on-White was found at only three sites. The Snake Valley Gray and Corrugated types were likewise rare, and other potential trade wares were found only at sites which yielded Snake Valley wares. These possible trade pieces include a variety of Anasazi

pottery at Snake Rock Village (42SV5, Aikens 1967), two possible Anasazi corrugated sherds from 42EM2065, and two Promontory Gray (?) sherds from 42EM2068. Edge-ground sherds of Emery Gray were found at three sites, and may have been fragments of spindle whorls, pot smoothers or similar tools.

Type: Emery Gray, plain
No. of Collected Sherds: 60
Provenience: 22 sites (collections from 14), 3 IFs; 42EM669, 1982, 2004, 2005, 2006, 2038, 2042, 2043, 2045, 2050, 2051, 2060, 2062, 2065, 2066 and 2068; 42SV5, 474, 2033, 2053, 2058 and 2062; EMIF-124-1, 337-1 and 421-1.
Identifying Characteristics: crushed gray basalt temper with minor amounts of sand and biotite mica, usually in a medium to dark gray paste with smoothed exterior surfaces.
Illustration: Figure 17
Suggested Affiliation and Age: San Rafael Fremont; AD 700-1200

Type: Emery Gray, decorated
No. of Collected Sherds: 8
Provenience: five sites (collections from four; fifth site excavated and no further collections taken); 42EM2051, 2065, 2066 and 2068; 42SV5
Identifying Characteristics: identical to above--crushed gray basalt temper primarily--with exterior surface modifications. Decorations are quite variable: fugitive red wash (EM2051), neck banded (EM2065), appliqued (EM2065), narrow coiled (EM2066) and incised (EM2068) sherds are represented. Greatest diversity is at Snake Rock Village (Aikens 1967:Fig. 19), where no further collections were made.
Illustration: Figure 17
Suggested Affiliation and Age: San Rafael Fremont; AD 700-1200, especially AD 950-1200.

Type: Emery Gray, worked sherds
No. of Collected Sherds: 3
Provenience: three sites (collections from two; third site is Snake Rock Village); 42EM2051 and 2060, 42SV5
Identifying Characteristics: identical to above, with ground edge or



Ceramics from the Emery and Scattered Small Tracts.

A: EMIF-421-1, Emery Gray rim sherds
B: 42EM2066-2, Emery Gray handle fragment
C: 42EM2051-1, Emery Gray with fugitive red wash
D: 42EM2065-3, Emery Gray, neck banded
E: 42EM2066-2, Emery Gray, neck banded
F: 42EM2065-1, Emery Gray, punctated applique
G: 42EM2068-3, Emery Gray, incised
H: 42EM2066-2, Sevier Gray
I: 42EM1999-1, Ivie Creek Black-on-White, unslipped Sevier variety
J: 42EM2051-1, Emery Gray worked sherds: spindle whorl(?)
K: SST-IF-M, Snake Valley Gray with applique rim
L: 42EM2044-2, Snake Valley Corrugated
M: 42EM2068-8, Promontory Gray
N: 42EM2065-10, Kayenta(?) Anasazi corrugated sherd

FIGURE 17

edges in all cases. Two sherds from EM2051 fit together and appear to have a center perforation as if used as a spindle whorl. Others may be pot smoothers; many examples are illustrated by Aikens (1967:Fig. 23).

Illustration: Figure 17

Suggested Affiliation and Age: San Rafael Fremont; AD 700-1200

Type: Sevier Gray, plain

No. of Collected Sherds: 24

Provenience: 11 sites (collections from seven, not including Snake Rock Village); 42EM1999, 2002, 2042, 2047, 2051, 2060, 2065, 2066 and 2068; 42SV5 and 2062

Identifying Characteristics: primarily crushed black basalt temper with minor amounts of sand and biotite mica, often in a tan/light gray paste with smoothed surface (but temper particles commonly protrude through interior surface). Differs from Emery Gray only in temper color (less so in size of temper particles) and in having slightly rougher surface texture; some vessels may have been manufactured locally, but this issue is still unsolved.

Illustration: Figure 17

Suggested Affiliation and Age: Sevier(?) Fremont; AD 800-1250

Type: Ivie Creek Black-on-White

No. of Collected Sherds: 2

Provenience: three sites (collections from two; third site is Snake Rock Village); 42EM1999, 42SV5 and 2043

Identifying Characteristics: carbon-painted sherds with temper characteristics of Emery Gray (SV2043) or Sevier Gray (EM1999). Neither of the collected sherds is slipped, as some Ivie Creek vessels are, and the one from 42SV2043 has red-tinted paint from misfiring in an oxidizing atmosphere. Numerous examples are illustrated by Aikens (1967:Figs. 20 and 21).

Illustration: Figure 17

Suggested Affiliation and Age: San Rafael Fremont; AD 700-1200, especially AD 1000-1200.

Type: Snake Valley Gray

No. of Collected Sherds: 3

Provenience: two sites, one IF; 42EM2065 and 2068 (plain sherds), SST-IF-M (appliqued rim sherd)

Identifying Characteristics: fine sand temper in a buff/brownish gray paste with smoothed but "gritty" surfaces. Surface texture and lack of igneous temper particles contrast with Emery and Sevier types. Over one hundred Snake Valley sherds were recovered from Snake Rock Village (Aikens 1967:19-20), but all were of Black-on-Gray type.

Illustration: Figure 17

Suggested Affiliation and Age: Parowan Fremont; AD 900-1200

Type: Snake Valley Corrugated

No. of Collected Sherds: 1 rim

Provenience: one site, 42EM2044

Identifying Characteristics: identical to Snake Valley Gray with addition of exterior corrugations. This sherd is badly weathered on the exterior, partially obliterating the corrugations. Corrugated pottery was recovered from Snake Rock Village, but most sherds there were variations of Emery and Sevier wares (Aikens 1967:Table 1).

Illustration: Figure 17

Suggested Affiliation and Age: Parowan Fremont; AD 1100-1200

Type: Promontory Gray (?)

No. of Collected Sherds: 2

Provenience: one site, 42EM2068

Identifying Characteristics: paddle-and-anvil construction technique, thick undulating vessel walls with coarse sand/rock temper in a medium brownish-gray paste. These two sherds fit together, have a reddish tinge on the interior half of the core from partial oxidation during firing, and are quite reminiscent of "Shoshonean" Intermountain Ware usually found north and east of the Castle Valley area (cf. Dean 1983).

Illustration: Figure 17

Suggested Affiliation and Age: Great Salt Lake Fremont; AD 1000-1300

Type: unknown corrugated (Kayenta Anasazi?)

No. of Collected Sherds: 2

Provenience: one site, 42EM2065

Identifying Characteristics: thin, well-made corrugated jar body sherds with crushed sherd(?) temper, containing very minor amounts of fine sand in an even gray paste. Most likely of Anasazi origin; numerous Anasazi ceramic sherds were found at Snake Rock Village, primarily from the Kayenta branch (Aikens 1967:28). The lack of crushed igneous rock temper and presence of minor amounts of fine sand temper in the sherds from EM2065 also suggest a Kayenta rather than Mesa Verde affiliation in this case (e.g., Breternitz et al. 1974:18-22).

Illustration: Figure 17

Suggested Affiliation and Age: Kayenta Anasazi; AD 1000-1250

The evidence from Snake Rock Village (Aikens 1967) and the Bull Creek area (Jennings and Sammons-Lohse 1981) might lead one to conclude that Anasazi ceramics are common in the San Rafael Fremont area. However, our survey data confirm earlier suggestions that very few sites in the Castle Valley area show contact with Puebloan groups to the south or southeast; Madsen (1975a:27) notes that Anasazi ceramics are generally absent from Fremont sites north of Ferron Creek (also see Thomas et al. 1981:161; Tipps et al. 1984:123; Reed and Chandler 1984:28, 35). Dean (n.d.) believes, as others have posited (see Madsen 1975a:15), "that there does appear to be a replacement of mineral paint [Snake Valley Black-on-Gray] with carbon paint [Ivie Creek Black-on-White] during PIII times in the Fremont as there is in Anasazi prehistory." If Ivie Creek Black-on-White is primarily a late Fremont trait, then the paucity of that type along with the dearth of Anasazi ceramics and possible late Fremont traits such as decorated Emery Gray pottery and coursed masonry surface structures (Madsen 1975a:23) all suggest that early Fremont (AD 700-1000) sites outnumber late Fremont sites (AD 1000-1200) by a substantial margin in the Castle Valley area.

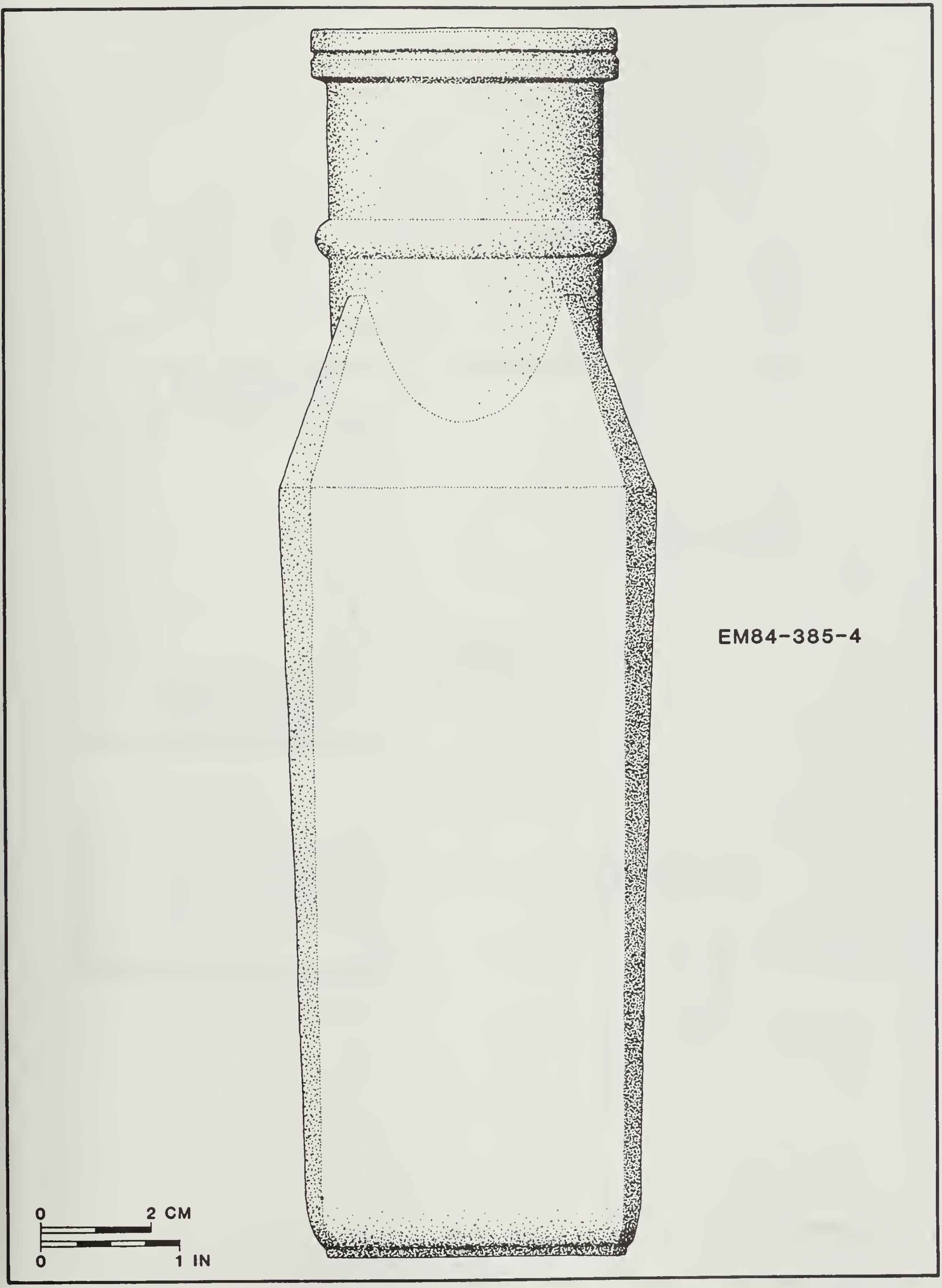
The implication is that the voluminous excavation data available for the San Rafael Fremont area are biased toward the later, more complex sites--not a surprising conclusion given the tendency in past years to emphasize the larger village sites in research rather than the small "boondocks" sites most commonly encountered during sampling and large

block surveys. Nine sites in the Emery and Scattered Small Tracts yielded decorated and/or intrusive pottery types suggesting occupation during late Fremont times: 42EM1999, 2044, 2051, 2060, 2065, 2066, 2068, SV5 and 2043. At least twice as many sites have Fremont components which lack such evidence, and many other multiple activity sites with large burned rock features but no diagnostic ceramics probably are of Fremont affiliation. It may be cliche to say, but more work is needed to define the nature and chronology of Fremont behavior patterns in this region.

Five other collected artifacts remain to be described. Fremont short-term camp site 42EM2043 yielded a fragment of a worked shell tinkler or bead (Figure 19) of the family Conidea (Conus spp.; see Morris 1966 and Cernohorsky 1971). The shell has been modified by abrading the spire from one end, and drilling a hole through the body whorl at the opposite end just above the base; stringing many such shells together produced a tinkling sound. An example of strung Conus shells from the Mimbres area is illustrated by Tower (1945:Plate Ig). The genus Conus includes over 400 species from 0.5 to 8.0 inches long (1.27-20.32 cm), having a world-wide distribution in tropical marine waters. Unfortunately, the specimen from EM2043 cannot be identified beyond the genus level, but it may have been traded in from the Gulf of California-Pacific Ocean area since Olivella shells from the same area are occasionally found at Fremont sites (e.g., Malouf 1939, 1940; Taylor 1957:108-112; Gunnerson 1969:156).

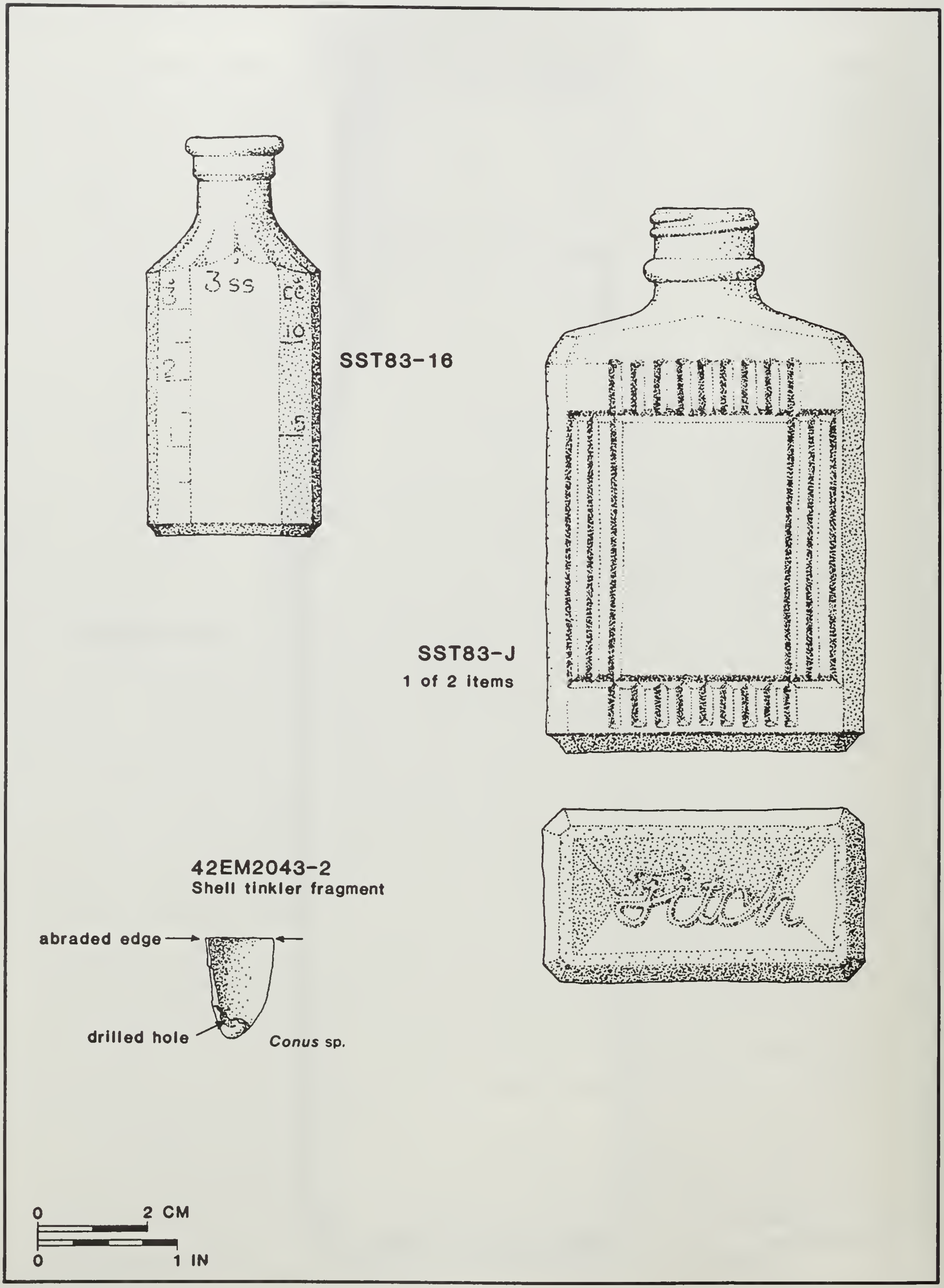
Four Historic period bottles also have been collected (Figures 18-20). Figure 18 illustrates a purple glass pickle jar having an "American square pickle" shape (Wilson 1981:89, 111). Our isolate from EMIF-385-4 measures 8 7/8" in height and is 2 3/8" x 2" at the base. Its molded construction, extract-lip neck finish and square shape date the jar to ca. 1865-1890, and its amethyst color suggests use between 1880 and 1915 (ibid.; Kendrick 1964:45). Thus, the pickle jar may represent occupation in the period 1880-1890. The remaining three bottles all post-date 1903 as indicated by the body mold seams extending over the neck--a characteristic of machine-made bottles (Wilson 1961:5-6).

In Figure 19, two small clear glass medicine bottles are depicted. Isolated find SST-IF-16 is a prescription bottle with graduated scales for metric and English measures. It probably accepted a cork stopper, suggesting use prior to 1930 (Firebaugh 1983:21), but little other



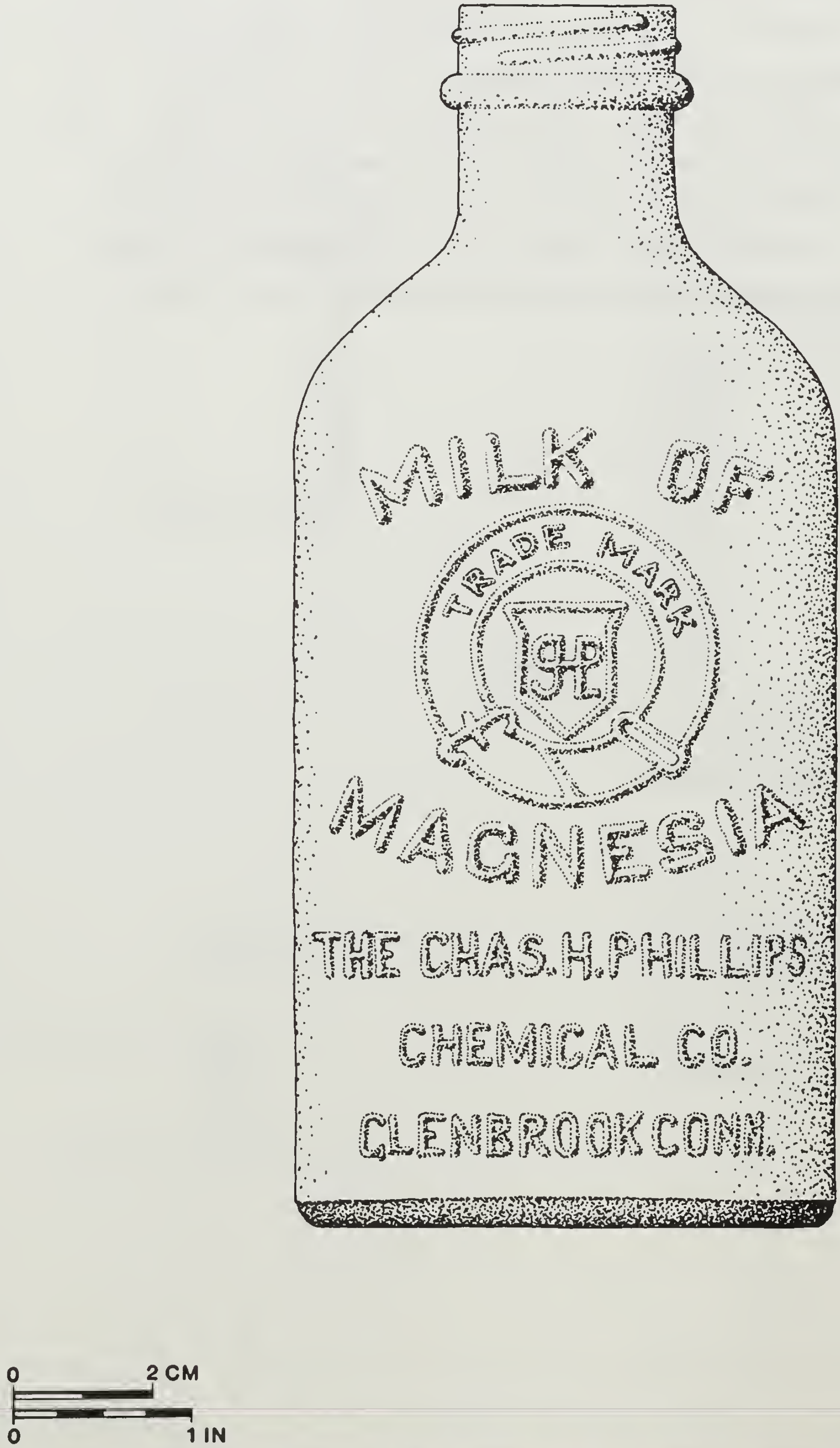
PICKLE JAR

FIGURE 18



SHELL AND GLASS ARTIFACTS **FIGURE 19**

information could be found in the literature (Putman 1965; Kauffman and Kauffman 1966; Berge 1980) other than its post-1903 date of manufacture. The second clear glass bottle, SST-IF-J, is a slightly larger container that took a screw-type cap. Its base is embossed with the name "Fitch" in script form, suggesting two possible companies: the Fitch Remedy Co. of Racine, Wisconsin or F.W. Fitch's Ideal Dandruff Cure Co. of Boone, Iowa. This bottle may date to the period 1903-1915 (Devner n.d.). Finally, Figure 20 shows a cobalt blue Phillips milk of magnesia bottle, also machine-made with a screw-on cap, from SST-IF-J. The bottle post-dates 1903, but no further chronological data are available (Wilson 1961).



SST83-J
2 of 2 items

MILK OF MAGNESIA BOTTLE

FIGURE 20

CHAPTER 5

Synthesis and Interpretations

Predictive Modelling: Introduction

The predictive modelling process originally proposed for the Castle Valley Class II called for the use of discriminant function and logistical regression-based multivariate statistical models, to be done at intervals in a sampling survey of two separate study tracts. Models were to be done in three stages, two at early intervals of fieldwork, and a final model at fieldwork completion. Modelling intervals were to be agreed upon by the BLM and the contractor.

The two study areas differ greatly in physical characteristics and in patterns of prehistoric use. The Elmo Tract is characterized by low desert scrub and very low site densities. The Emery Tract is dominated by pinyon-juniper upland and has a high, but quite variable, site density. A consequence of the very low site densities in the Elmo Tract was an inadequate sample size for statistical modelling at early increments of fieldwork. In fact, the only and final model is based on a very limited data base.

For the Emery Tract, sufficient numbers of previously recorded sites were found through files searches to generate a pre-field model. Although not technically based on a random sample, this model worked reasonably well when tested against independent data and provided direction to successive models. The second-stage model was based on a separate data set, sites recorded within our randomly generated sample of survey units.

Rather than producing a single final model, two models each based on 100% completion of fieldwork are presented below. One of these operates on 40 acre quadrats as the basic unit of measurement; the other model is a site-nonsite model based on all sites within our sample units. The strengths and weaknesses of each model are discussed below.

Thoughts on Modelling Theory and Method

Our approach to modelling is based on that used by Kvamme (1980, 1983) in the BLM-Glenwood Springs Resource Area of Western Colorado (Burgess *et al*. 1980), and is patterned more precisely after other Class II models our firm has worked out in Wyoming and Utah (Peebles 1981; Zier and Peebles

1982; Peebles et al. 1983a, 1983b; Black et al. 1984). Similar approaches have been quite widely used in Utah (cf. Tipps et al. 1984; Bradley et al. 1984; Holmer 1979, 1982; Larralde and Chandler 1982, among others).

The general approach has been termed "cookbook" by Berry (1984:846) in a rather scathing review of predictive modelling of this sort, but to put such a simplistic label on it is misleading. The approach is similar whether one is working in the heart of the Great Basin or on the Northwestern Plains, but specific variables used in analysis differ and, to a large extent, depend on a working knowledge of contemporary hunter-gatherer theory and an understanding of local prehistoric cultural patterns and processes.

The "cookbook" aspect of the approach is more a product of the statistical method than an unreasoned grasping for a panacea as Berry seems to imply. The approach is based on discriminant analysis, a technique for statistically distinguishing between two or more groups or cases, the groups being defined by the research situation (Klecka 1975:435). In the case of predictive modelling the primary groups are 1) locations where sites occur, and 2) locations where sites do not occur (non-sites) (Kvamme 1980). Some researchers choose to add a third or fourth group by asking the model to distinguish between non-sites and one or more site types, or locations with one versus multiple sites (cf. Peebles 1981; Schroedl 1984).

This is done by selecting a collection of "discriminating variables" that the researcher thinks will measure differences between the groups. Discriminant analysis attempts to mathematically combine these discriminating variables into one or more linear combinations or

"discriminant functions" (see Klecka 1975:435) which results in a maximum statistical separation between groups. Once the discriminant functions have been defined, classification coefficients can be used to assign unknown cases to one of the original groups (Klecka 1980).

Typically, the Statistical Package for the Social Sciences (SPSS) version of discriminant analysis (Nie et al. 1975) is used by researchers because it is widely available on university mainframe computers and is, thus, widely accessible. For Castle Valley, the Biomedical Data Package (BMDP) version was used on the University of Denver's DEC VAX-11 computer because the same data set entered for discriminant analysis could be subjected to logistical regression analysis as well, an option not included on the available versions of SPSS at the time the pre-field models were run (both options are now available for SPSS on some computers). Although not a major goal of the project, one task was to use both multivariate techniques on the same data set and to compare the methods (see Press and Wilson 1978; Parker 1983).

Variable Selection

The discriminating variables are selected based on the researcher's estimation of each variable's ability to distinguish between the predefined groups. Traditionally, these variables have been chosen because they seem to have some correlation to deliberate settlement choices made by the prehistoric inhabitants. For example, Kvamme (1980:93) makes use of Jochim's (1976) analysis of hunter-gatherer settlement patterns in deriving the variables he selected for measurement, and other researchers have followed his example (e.g.,

Peebles 1981; Zier and Peebles 1982). Commonly measured variables have included vertical and horizontal distance to a water source, distance to a point of vantage, view quality (view spread in a downhill direction), shelter quality, aspect, relief, slope or grade, local relief, presence/absence of fuel wood and others. In many cases, these attributes do have a correlation with site locations which has been demonstrated by survey data or observed in contemporary hunter-gatherer groups (cf. Jochim 1976; but also see Bettinger 1980).

Factors such as the adaptive pattern of the occupants and purpose of occupation will have influenced the decisions underlying site placement. The choice of any specific point probably represented a compromise between a range of possibilities given the environment of the time and the range of activities being pursued. The use of multiple discriminating variables which were thought to have weight in prehistoric settlement selection allows for a variety of dissimilar location types to show up in the site-suitable group, and also for a variety of unsuitable locations to be distinguished.

A limiting factor for variable selection is that for a model to be readily applicable to a large study area, each variable must be measurable without separate field observation. That is, through use of available maps, aerial photographs, vegetation overlays and similar tools, one should be able to sit in the lab and make the battery of measurements necessary to the model. In some cases, this severely limits the choice of variables or allows only gross measurements of resources with complex, small-scale distributions. This limitation is currently being partially addressed by use of digitized map data bases, but this sort of resource was not available for this study.

For example, some soil types, particularly aeolian sands, have been demonstrated to have very strong correlation with high site densities in certain areas of Utah and southwestern Wyoming (Holmer 1979; Metcalf 1976). Regional soil maps are lacking for many areas of the west, however, and remote imagery such as that used by Kolm (1974) in his study of Wyoming dunefields lack the resolution to detect small pockets of such deposits which nevertheless had a profound effect on local settlement patterns. Unless a research team has the resources to locate and create overlays of the distribution of such a variable type, the variable cannot

be used in the model even though it is important. A good example of the latter is the Goodson Associates Cisco Desert Class II where a soils team created base maps for just this purpose (Bradley et al. 1984).

Another point that should be mentioned prior to specific discussion of the modelling concerns the difference between explanation and correlation. Despite the use of previously generated settlement pattern data and reliance upon ethnographic analogy and contemporary hunter-gatherer analysis in selecting variables for measurement, we do not suppose that the resultant model is wholly explanatory. To be sure, the variables are selected because we believe them to reflect elements of prehistoric settlement locational choices. Distance to water, slope, aspect, and many other variables were undoubtedly considered in the prehistoric decision-making process, and our models can provide measurements of the strengths of interrelationships between settlement location and a given variable. This may provide explanatory clues as to why certain settlement choices were made and aid us to understand something about why or why not the model is working. But, to notice a correlation between a variable and high site densities does not constitute proof of a cause and effect relationship. For purposes of the model, we do not need to know why the correlation exists between the occurrence of a site and some variable. As archaeologists, as opposed to modellers, however, the question is of importance.

An example of this, drawn from the Washakie Basin study area in southwest Wyoming, is the variable "elevation". Measurement of this variable proved to have very strong predictive value since almost all of the sites recorded in the study area are below 7,400 ft even though much of the study area is higher (Peebles et al. 1983a:142). Knowledge of this is important for predictive modelling, but does not explain the underlying behavior. All of the vast number of sand dunes and most of the water sources in the study area are also below 7,400 ft, so the variable "elevation" operates simply as a "shadow" or secondary measurement of some other variable(s) which might relate more directly to deliberate settlement choices. There is a similar correlation between elevation, high site densities and the distribution of pinyon-juniper in the Castle Valley study area.

The Castle Valley Variables

The final selection of variables for the Castle Valley analysis was an outgrowth of earlier modelling stages. Initially, 11 variables were coded including site type and, following the preliminary modelling, four additional variables were added including number of sites.

1) hddw - horizontal distance to a defined water source. This variable is a straight line distance from the measuring point (site or center of quadrat) to a defined water source. For analytical purposes main drainages below major confluences of intermittant washes were labeled as "water sources" since it is reasonable to assume that such features would hold water seasonally or following major storms. Running streams or springs are also included as water sources.

2) vddw - vertical distance to a defined water source. This measures the difference in elevation between the measuring point and the nearest defined water source.

3) relief a - measures the amount of relief in a 1/4 mi radius from the measuring point.

4) relief b - measures the amount of relief in a 1/2 mi radius from the measuring point.

5) grade - measurement of the percent of slope across the measuring point using the topographic map and a land locator template.

6) aspect a - measures the aspect at the measuring point with raw azimuth rescaled to fit between 0-180°. For example, a compass reading of 90° and one of 270° would each be coded as 90° since each deviates from north by 90°.

7) aspect b - raw azimuth or aspect read 0-360° from a protractor placed on the measuring point.

8) elev - elevation of the measuring point simply read from the topographic contours.

9) viewqual - measured as degrees of unobstructed viewspread extending downhill from the measuring point for a minimum distance of 1/2 mi. Where a measuring point is in a stand of trees on level terrain, the view is considered to be obstructed.

10) distpj - measured as the straight line distance between the measuring point and the nearest stand of at least five trees. The variable is measured on orthophotoquad maps. For the most part this is pinyon-juniper woodland, but in a few cases field observation proved that only juniper is present.

11) site type - this served as a group identification variable where non-sites were recorded as a 0; sites as a 1.

The remaining variables were initially measured only for quadrats and were used only in the final models. These variables are similar to those used for the final model for the P-III Tar Sands Class II (Tipps et al. 1984; Schroedl 1984:151-152).

12) pjeco - distance to pinyon-juniper ecotone was measures from the centerpoint of each quadrat. For points outside of pinyon-juniper this measurement is the same as distpj. For sites within the pinyon-juniper woodland the measurement is out to the woodland edge.

13) drainage - number of drainages within quadrat. Measurement is a count of blueline drainages, as indicated on topo maps, which fall within a quadrat.

14) pjcover - percentage of pinyon-juniper cover in quadrat; this is estimated to the nearest 10 percent by placing a 40 acre template over the unit on orthophotoquads.

15) sites - for surveyed quadrats this is a simple count of sites that are within or touch the quadrat. It should be noted that at this level of the model we are not concerned with estimates of overall site density. We are attempting to estimate how well a battery of measurements predicts site suitability for a given quadrat. Presumably sites located on quadrat boundaries are a fair estimate of site suitability since the boundary sites are in lands that are covered by our measurements.

The Prefield Model

Because the files search indicated that numerous sites had been recorded in the Emery Tract, we decided to attempt a model prior to fieldwork. At the time of modelling we had precise locations for 108 of the 125 aboriginal sites the files search eventually showed. Variables 1-11 described above were coded for each of the 108 sites and for 100 points chosen as the center point of 100 randomly selected 80 acre sample units. The 100 units were selected in the same manner as were the sample units for survey, via a random numbers program which prints all units in the sample universe in random order without replacement, but were taken from a separate draw. The resultant sample of "random points" were treated as "non-site" locations although we don't actually know since they have not, for the most part, been surveyed.

The data set generated in this fashion violates some of the assumptions of discriminant analysis and logistical regression since neither data group, "sites" and random points", is a truly random sample (cf. some objections set out by Berry 1984:847). Nevertheless, inspection of the distribution of sites and random points on maps shows no overt evidence of undue clustering or other kinds of skewing. Most of the sites are, in fact, located in randomly chosen survey quadrats although they were chosen from a completely different sampling universe and overlap our study area only by coincidence.

At this level of modelling we were looking only for information to guide future versions of the model. Despite the lack of purely statistical reliability inherent in such use of statistics we felt the resultant information would prove worthwhile.

The above data set was subjected to both analyses, discriminant and logistical regression, using BMDP7M stewise discriminant analysis and BMDPLR stepwise logistical regression on the DEC VAX-11 mainframe computer at the University of Denver. The results for each method were similar, as described below.

For discriminant analysis the group means for each variable and the results of the stepwise procedure are shown in Table 19. Table 20 shows the same results for the logistic run.

For the logistical regression-based model, the self-classification rate was 80% correct for sites and 60% correct for non-sites, for an overall classification rate of 70%.

When the discriminant model was tested against itself it correctly predicted sites 80.6% of the time and non-sites only 62% of the time, for an overall classification rate of 71.6%. The jackknifed classification results were 77% for sites and 53% for non-sites, with a 65% overall classification rate.

As a completely independent test, we then measured variables for 46 test cases by selecting the center-point of each 40 acre half of the initial 23 (50%) sample units drawn for survey in the Emery Tract, and used these to evaluate the models' performance. Using the classification function for each model we predicted raw probabilities for each of the 46 points. The results of this independent test showed that the real predictive value of the model must be very critically evaluated. If one

Table 19

Pre-field Model

Variable group means, standard devations, and stewise summary table for discriminant analysis. Includes 100 non-sites, 108 sites.

VARIABLE	GROUP = site	nonsite	ALL GPS.
2 hddw	3812.40747	4159.50000	3979.27681
3 vddw	259.90741	227.95000	244.54327
4 reliefa	162.36111	215.20000	187.76442
5 reliefb	286.48148	340.50000	312.45193
6 grade	11.94444	19.60000	15.62500
7 aspecta	81.06481	86.15000	83.50961
9 elev	6251.29639	6267.29980	6258.99023
10 viewqual	48.37963	57.45000	52.74038
11 distpj	382.40741	1045.00000	700.96155
COUNTS	108.	100.	208.

STANDARD DEVIATIONS

VARIABLE	GROUP = site	nonsite	ALL GPS.
2 hddw	2306.96021	3142.81836	2740.66357
3 vddw	133.28090	213.03967	176.17986
4 reliefa	99.21292	197.35361	154.37186
5 reliefb	163.18135	234.79143	200.80688
6 grade	10.99603	20.23349	16.11061
7 aspecta	47.94394	54.75776	51.33156
9 elev	216.28162	341.52615	283.46497
10 viewqual	73.67419	62.17236	68.50045
11 distpj	1267.77686	1452.26233	1359.56531

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SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	F VALUE TO ENTER OR REMOVE	NUMBER OF VARIABLES INCLUDED	U-STATISTIC	APPROXIMATE F-STATISTIC
1	11 distpj		12.3326	1	0.9435	12.333
2	4 reliefa		10.0267	2	0.8995	11.450
3	6 grade		5.5053	3	0.8756	9.658
4	9 elev		5.5593	4	0.8523	8.795
5	3 vddw		3.3564	5	0.8384	7.789
6	2 hddw		1.3817	6	0.8326	6.734
7	5 reliefb		0.1255	7	0.8321	5.765
8	10 viewqual		0.0396	8	0.8319	5.025
9	7 aspecta		0.0272	9	0.8318	4.448

Table 20

Emery Pre-field Model

Variable group means, standard deviations, and stepwise summary table for logistic regression. Includes 100 non-sites, 108 sites.

DESCRIPTIVE STATISTICS OF INDEPENDENT VARIABLES

VARIABLE NO.	NAME	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	SKEWNESS	KURTOSIS
2	hddw	0.0000	11700.0000	3979.2788	2739.5559	1.0105	0.6508
3	vddw	0.0000	990.0000	244.5433	176.4811	1.3762	3.5944
4	reliefa	20.0000	880.0000	187.7644	156.2558	2.1591	5.0520
5	reliefb	0.0000	990.0000	312.4519	202.1419	1.4074	1.2978
6	grade	0.0000	80.0000	15.6250	16.5227	1.9920	3.7568
7	aspecta	0.0000	180.0000	83.5096	51.2707	0.2163	-1.0077
9	elev	5600.0000	7040.0000	6258.9902	282.8929	0.1974	0.2604
10	viewqual	0.0000	320.0000	52.7404	68.4857	1.2941	1.1579
11	distpj	0.0000	9400.0000	700.9615	1396.2850	2.9400	10.1949

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SUMMARY OF STEPWISE RESULTS

STEP NO	TERM ENTERED	DF	TERM REMOVED	LOG LIKELIHOOD	IMPROVEMENT CHI-SQUARE	IMPROVEMENT P-VALUE	GOODNESS OF FIT CHI-SQUARE	GOODNESS OF FIT P-VALUE
0				-144.021			288.041	0.000
1	distpj	1		-137.454	13.132	0.000	274.909	0.001
2	grade	1		-132.512	9.885	0.002	265.024	0.003
3	elev	1		-127.346	10.333	0.001	254.691	0.009
4	reliefa	1		-126.258	2.176	0.140	252.515	0.010
5	vddw	1		-125.005	2.506	0.113	250.009	0.012
6	hddw	1		-124.328	1.354	0.245	248.655	0.012
7	viewqual	1		-124.184	0.287	0.592	248.368	0.011
8	reliefb	1		-124.091	0.185	0.667	248.183	0.010
9	aspecta	1		-124.056	0.072	0.789	248.111	0.009

specifies that a site must occur exactly at a measuring point (see below) where a site location was predicted, then the pre-field model, when tested against independent survey survey data (two measuring points from each of the initial 23 sample units), was far less accurate than either the logistic regression or discriminant analysis-based model indicated, either in self-classification or in jackknifed classification (jackknifed classification is a self-test routine independent of the initial classification and is available only for discriminant analysis; Jennrich and Sampson 1983:534).

In evaluating the performance of the pre-field models, the initial thing noticed was that both statistical procedures yielded almost identical results with a very slight edge in favor of discriminant analysis. The actual performance of both models, using the classification functions in each program ot predict group membership for the test cases--with a cut-point of 0.4 to predict site group membership for the test cases--gave an 11% correct classification rate for sites and a 95% correct classification rate for non-sites with a 46% overall classification rate. These figures were derived by interpreting any location with a group probability classification of 0.4 or above as a predicted site, and of less than 0.4 as a non-site, a cut-point which should bias the classification rate in favor of correct site group predications. Purely as an experiment we had further specified that a site must occur exactly at the measuring point. Inspection of topographic maps showed that in many instances the actual measuring point was either adjacent to a site, between several sites, or in specific position where a site would not occur under any circumstance (e.g. under Interstate 70 or in the channel of Ivie Creek), but sites did occur directly adjacent to the measuring point.

Since several of the variables cover an area measured around or across the measuring point (relief a, b, and grade for example), or are a scalar measure to some distant point, we felt it would be valid to evaluate the model's performance if one allowed close proximity to site occurrence to count as a "hit". We specified that if any site(s) overlapped the 40 acre quad where the measuring point was centered, then it would be classified as a correct prediction. The model was then evaluated with cut-points of 0.5 and 0.4 for site group membership with the following results:

0.5 logistic - 75% non-sites, 66% sites, 71% overall.

0.4 logistic - 61% non-sites, 82% sites, 74% overall.

0.5 discriminant - 86% non-sites, 66% sites, 80% overall.

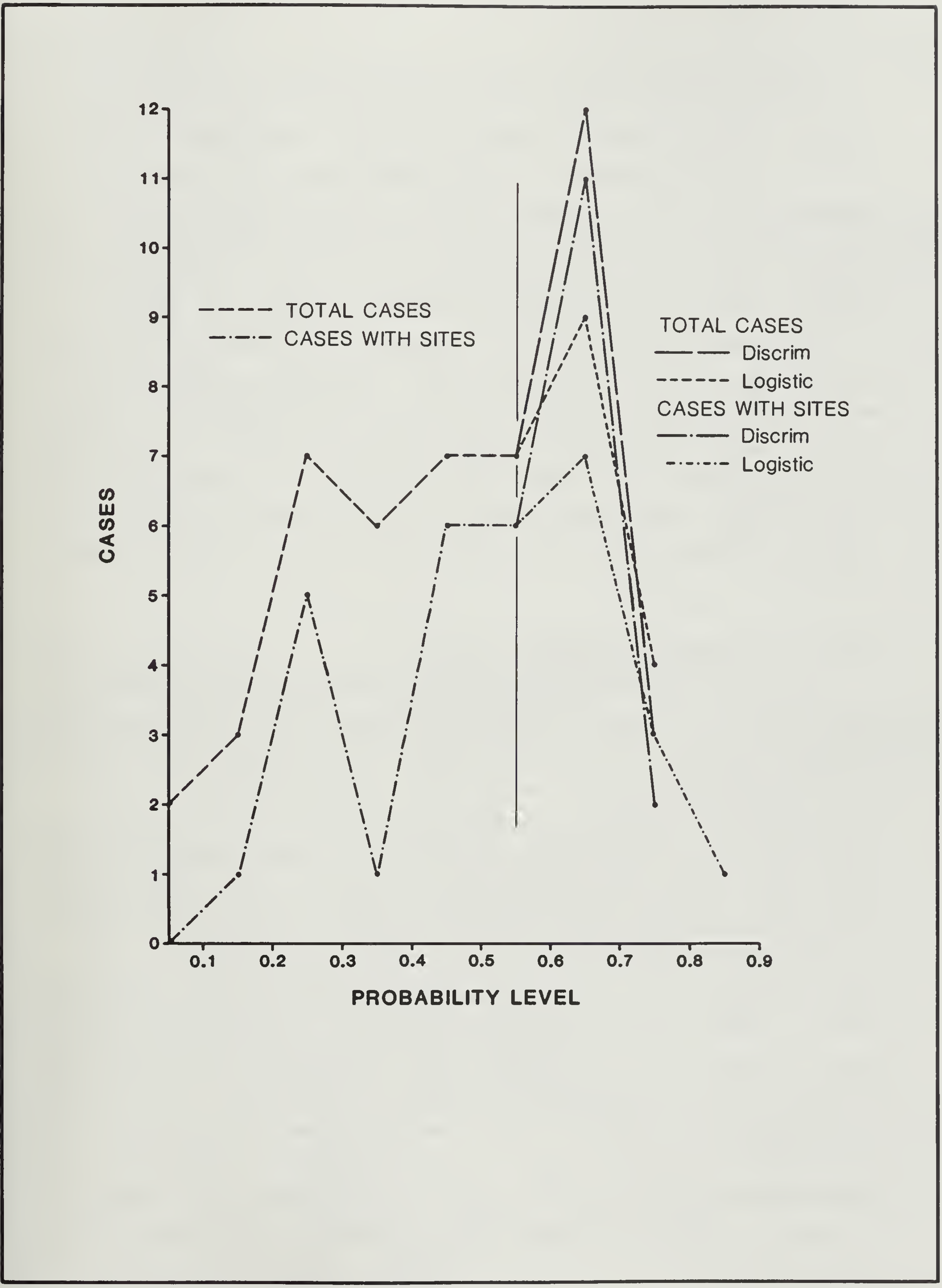
0.4 discriminant - 59% non-sites, 86% sites, 76% overall.

The above suggested that there is some predictive power in the modelling procedure and that either logistic regression or discriminant analysis is a suitable statistical method. It also suggests that use of a quadrat-based model might be appropriate since our measurements characterize an area larger than a site. First, the results from an actual test against independent data showed that the model is predicting site proximity with some accuracy, but does poorly if expected to predict a direct hit. A second consideration is that our randomly drawn measuring points are random only in the sense that the quads where they occur were randomly chosen. All points outside of quad centers are automatically excluded from the sample universe. With a quad-based sample, the sample is random. A third consideration is that a quad-based model can cover a larger area with fewer measurements.

A further consideration in the test data for the preliminary model is the distribution of incorrect site classifications, both in the predictive probabilities and on the ground. Figure 21 graphs the number of quads with sites occurring against the predicted probabilities for site occurrence. The plot shows that most of the incorrect site classifications occur in the 0.2-0.29 probability range. Of the cases thus classified, most are at low elevations adjacent to dependable water sources and the sites tend to be Fremont habitations. Other cases in this range which were misclassified are very steep over most of the quadrat, but have some gently sloping terrain and are in, or close to, pinyon-juniper woodland. These considerations, as they relate to further modelling efforts, are discussed below.

The Interim Model

Although originally proposed as a 50% increment model, this model is actually based on a partial data set from the initial 70% of fieldwork. The model uses 74 out of the total of 105 prehistoric sites in the Emery sample units, and it excludes Class I data except where a previously recorded site falls into one of our sample units.



PREFIELD MODEL TEST RESULTS **FIGURE 21**

The same procedure and battery of variables was used as in the preliminary model except that pjeco was also used. The 100 random points originally measured formed the "non-site" group. These points were not adjusted to reflect whether or not they actually are sites because the vast majority were not surveyed, these being taken from an independent draw. A stepwise discriminant analysis was performed with somewhat different results than that achieved by the first model. The stepwise procedure resulted in the ranking of variables as depicted in Table 21.

Performance of the model at a 0.5 cut-point was 74% for non-sites and 63.5% for sites, with a 69.5% overall rate. Jackknifed classifications were 68% for non-sites, 55.4% for sites, and a 62.6% overall rate. These rates are significantly lower for sites and lower overall than achieved by the pre-field model. The rather poor performance of this model led to our experiments with quadrat-based models, and to some experimenting with different variables. A final point-based model was run using the complete data set.

The Final "Site/Non-site" Model

For the final site/non-site model eight variables were used: hddw, vddw, relief a & b, grade, elevation, distpj, and pjeco. Group means and standard deviations and the stepwise summary are reflected in Table 22. The resulting model yielded a performance at a 0.5 cut-point of 60% for sites and 62% for non-sites, for an overall rate of 61%. The jackknifed classifications are only slightly lower at 59% for sites and 57.4 for non-sites, for an overall rate of 58.2%. If a cut-point of 0.4 probability for site group membership is used the performance of the model is about the same overall, 62%, but the rates are 85% for sites and 36% for non-sites. Use of a 0.4 cut-point is suggested by examining group probability scores in the discriminant print-out (Appendix 4). As is evident above, much of the variability in the model comes from locations (both sites and non-sites) with discriminant scores between 0.4 and 0.5.

Adjusting the cut-point for group membership does not improve the overall performance of the model, but it can render a relatively weak model more useful by biasing the rate of misclassifications in favor of one group or another. By adjusting the cut-point for site group

Table 21

Interim Model

Variable group means, standard deviations, and stepwise summary table. Includes 100 non-sites, 108 sites.

GROUP =	nonsite	site	ALL GPS.
VARIABLE			
2 hddw	4157.70020	5323.64844	4653.56299
3 vddw	227.95600	437.83783	317.21265
4 reliefa	215.20000	201.10811	209.20689
5 reliefb	340.50000	414.45947	371.95401
6 grade	19.60000	12.05405	16.39080
7 aspecta	86.15000	76.14865	81.89655
9 elev	6267.29980	6400.27051	6323.85059
10 viewqual	57.45600	65.87839	61.03448
11 distpj	1045.00000	841.21619	958.33331
14 pjeco	996.00000	1062.16211	1024.13794
COUNTS	100.	74.	174.

STANDARD DEVIATIONS

GROUP =	nonsite	site	ALL GPS.
VARIABLE			
2 hddw	3141.83613	4309.31006	3682.82080
3 vddw	213.03967	428.40988	322.51968
4 reliefa	197.35361	192.68517	195.38585
5 reliefb	234.79143	238.18889	236.23932
6 grade	20.23349	12.45253	17.36238
7 aspecta	54.75776	53.47223	54.21587
9 elev	341.52615	467.12738	409.69189
10 viewqual	62.17236	95.77141	78.21566
11 distpj	1452.26233	1616.99780	1524.35522
14 pjeco	1167.13599	1554.77759	1345.37061

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SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	F VALUE TO ENTER OR REMOVE	NUMBER OF VARIABLES INCLUDED	U-STATISTIC	APPROXIMATE F-STATISTIC
1	3 vddw		18.0113	1	0.9052	18.011
2	4 reliefa		7.0389	2	0.8694	12.841
3	6 grade		3.7657	3	0.8506	9.955
4	9 elev		2.8759	4	0.8363	8.267
5	5 reliefb		1.7870	5	0.8275	7.002
6	10 viewqual		1.8439	6	0.8185	6.172
7	11 distpj		0.9394	7	0.8139	5.422
8	14 pjeco		3.9281	8	0.7950	5.319
9	2 hddw		0.3407	9	0.7933	4.747
10	7 aspecta		0.1985	10	0.7924	4.271

Table 22

Final Point Model

Variable means, standard deviations, and stepwise summary table. Includes 100 non-sites, 105 sites.

PAGE 2 BMDP7M EMERY TRACT SITE NONSITE MODEL LAST TRY

MEANS

GROUP =	nonsite	site	ALL GPS.
VARIABLE			
2 hddw	4157.70020	4842.12939	4513.07715
3 vddw	227.95000	350.37036	291.51443
4 reliefa	215.20000	201.09259	207.87500
5 reliefb	340.50000	404.87036	373.92307
6 grade	19.60000	12.80556	16.07211
9 elev	6267.29980	6350.83350	6310.67285
11 distpj	1045.00000	758.10187	896.03363
14 pjeco	996.00000	910.87964	951.80286
COUNTS	100.	108.	208.

STANDARD DEVIATIONS

GROUP =	nonsite	site	ALL GPS.
VARIABLE			
2 hddw	3141.83813	4353.77246	3819.63794
3 vddw	213.03967	382.45929	312.71313
4 reliefa	197.35361	170.88226	184.07967
5 reliefb	234.79143	221.73793	228.10442
6 grade	20.23349	14.20508	17.36542
9 elev	341.52615	427.62531	388.63556
11 distpj	1452.26233	1417.22888	1434.17224
14 pjeco	1167.13599	1381.11548	1282.74341

PAGE 10 BMDP7M EMERY TRACT SITE NONSITE MODEL LAST TRY

SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	F VALUE TO ENTER OR REMOVE	NUMBER OF VARIABLES INCLUDED	U-STATISTIC	APPROXIMATE F-STATISTIC
1	3 vddw		7.9575	1	0.9628	7.957
2	6 grade		6.8074	2	0.9319	7.495
3	4 reliefa		1.6976	3	0.9242	5.579
4	5 reliefb		3.9291	4	0.9066	5.227
5	11 distpj		1.3208	5	0.9007	4.452
6	9 elev		3.3499	6	0.8860	4.312
7	14 pjeco		1.7702	7	0.8782	3.963
8	2 hddw		0.1613	8	0.8775	3.473

membership to 0.35, for example, sites are correctly classified 94% of the time but non-sites at only a 28% rate. If one were using the model to select specific points to look for sites and wanted to be sure few sites would be missed the use of a low cut-point would make sense, but it would result also in misclassifying numerous non-sites as site locations. This aspect of discriminant models should be kept in mind for any use of the predictive model.

The misclassified sites were charted to see if any patterning exists in site type or site setting. At the 0.5 site group probability level, 46 cases (sites) are missed while at the 0.4 level 15 are misclassified. Only weak patterning exists in the missed predictions at the 0.5 level, but this patterning is stronger at the 0.4 level. For example, 12 of 20 sites with Fremont components are missed at 0.5, but only two are missed at 0.4 and one of these has a site group probability of 0.391. At both the 0.5 and 0.4 levels seven of 15 quarry components are misclassified as non-sites. This is almost half of the quarries and likewise is almost half of the total misclassifications. Other site types missed at the 0.4 level include five chipping scatters, two habitations (both Fremont), a rockshelter and three short-term camp site components.

In terms of some environmental variables, the average elevation of sites missed at the 0.4 level is lower at 6,170 ft than even the average of the non-site group (6,267 ft) or of the site group (6,351 ft). Average distance to permanent water for correctly classified sites is 2,283 ft, for misclassified sites it is 1,297 ft. While some 75% of the sites have pinyon-juniper on or directly adjacent to the site, this figure drops to 48% for misses at the 0.5 level and 60% for missed cases at the 0.4 level.

We will return to some of these patterns in evaluating the performance, and the faults of the various models. This discussion will follow presentation of our quadrat-based models.

The Emery Quadrat Model

In order to produce the quadrat-based model, the battery of variables described earlier was measured for each of the sample units surveyed in the Emery Tract. To increase the sample size, however, each 80 acre sample unit was divided into two 40 acre quadrats so that each half could be treated as a separate case. Thus, 92 cases are used in the quadrat

analysis. Within these 92 cases, there are 29 quadrats which do not contain sites, and the remainder have one or more sites.

Two discriminant runs were made for this data set, one using 13 discriminating variables and a second run using eight discriminating variables. The variables, means and standard deviations, and stepwise rankings are shown in Tables 23 and 24.

The first run, with a full battery of variables, gave a self-classification rate of 82.8% for non-site quads and 82.5% for site quads, for an 82.6% overall classification rate (this with a 0.5 cut-point). The jackknifed classification rates fall to 69% for non-site quads and 69.8% for site quads, with an overall 69.5% classification rate.

The rational for eliminating variables for the second discriminant run was two-fold. First, some of the measurements apply more directly to point locations than to quadrats, including grade, aspect, and view quality; and second, it seemed possible that the several separate measures of pinyon-juniper and elevation might be interfering with one another. Therefore, an experimental run was made using just eight variables.

The classification rates for the "reduced variable" model were 86.2% for non-site quads and 73% for site quads, with an overall rate of 77.2% using a 0.5 cut-point. The jackknifed classification rate dropped to 79.3% for non-site quads and 69.8% for site quads, with an overall classification rate of 72.8%. This model is slightly less accurate than the run using the full set of variables but, after the jackknifed test, performs slightly better.

Following presentation of the preliminary quadrat-based model some experimentation was done with the variables used and the way in which they were measured, and several computer runs using combinations of these variables were done. Specifically, for the variable "drainages" both blueline drainages and drainages indicated by "V's" in contours on the topo maps were counted. Several variables were added as well:

sp1 - this is an estimate of the average slope of a quadrat measured by placing a template over the quad and estimating the predominant slope (grade) in 20% increments. These increments were scaled from 1 to 5.

avelev - this is the median elevation within a quadrat as read from topographic sheets.

MEANS

GROUP =	nonsite	site	ALL GPS.
VARIABLE			
2 hddw	6012.06885	5106.34912	5391.84766
3 vddw	331.31033	330.96826	331.07608
4 reliefa	286.72415	210.31746	234.40218
5 reliefb	480.48276	368.96826	404.11957
6 grade	24.20690	14.76190	17.73913
7 aspecta	86.03448	89.68254	88.53261
9 elev	6320.34473	6353.80957	6343.26074
10 viewqual	68.79311	45.07936	52.55435
11 distpj	1105.17236	693.65082	823.36957
12 pjcover	13.79310	38.41270	30.65217
13 pjeco	1324.13794	877.38098	1018.20654
14 drainage	0.58621	0.68254	0.65217
16 avelev	6350.68945	6342.38086	6345.00000

STANDARD DEVIATIONS

GROUP =	nonsite	site	ALL GPS.
VARIABLE			
2 hddw	2787.58911	4015.25781	3677.50024
3 vddw	263.67419	309.06195	295.68684
4 reliefa	201.44246	170.69798	180.82396
5 reliefb	277.57104	227.49187	244.17519
6 grade	29.00539	17.61205	21.80423
7 aspecta	52.65079	101.80516	89.50249
9 elev	285.08746	405.94943	372.57336
10 viewqual	55.23740	62.63368	60.42971
11 distpj	1042.17700	1239.87917	1181.92029
12 pjcover	29.20540	36.72945	34.56460
13 pjeco	1201.90479	979.84430	1053.95557
14 drainage	0.50123	0.71449	0.65562
16 avelev	251.93439	380.16855	345.41327

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	F VALUE TO ENTER OR REMOVE	NUMBER OF VARIABLES INCLUDED	U-STATISTIC	APPROXIMATE F-STATISTIC
1	12 pjcover		10.0751	1	0.8993	10.075
2	16 avelev		11.3693	2	0.7975	11.303
3	5 reliefb		4.8531	3	0.7558	9.479
4	13 pjeco		5.1774	4	0.7133	8.741
5	9 elev		2.4946	5	0.6932	7.612
6	6 grade		1.4199	6	0.6818	6.611
7	7 aspecta		1.3358	7	0.6712	5.880
8	14 drainage		0.2570	8	0.6691	5.131
9	2 hddw		0.1081	9	0.6682	4.524
10	3 vddw		0.0895	10	0.6675	4.036
11	11 distpj		0.0365	11	0.6672	3.628
12	10 viewqual		0.0305	12	0.6669	3.288
13	4 reliefa		0.0235	13	0.6667	3.000

Table 23. Emery Quad Model-Preliminary

Variable group means, standard deviations, and stepwise summary table. Includes 29 non-site quadrats, 63 quadrats with sites.

Table 24

Emery Quad Model-
reduced variables

Variable group means, standard deviations, and stepwise summary table. Includes 29 non-site quadrats, 63 quadrats with sites.

GROUP =	nonsite	site	ALL GPS.
VARIABLE			
2 hddw	6012.06685	5106.34917	5391.84766
3 vddw	331.31033	330.96826	331.07608
4 reliefa	286.72415	210.31746	234.40218
5 reliefb	480.48276	368.96826	404.11957
12 pjcover	13.79310	38.41270	30.65217
13 pjeco	1324.13794	877.38098	1018.20654
14 drainage	0.58621	0.68254	0.65217
16 avelev	6350.68945	6342.38086	6345.00000
COUNTS	29.	63.	92.

STANDARD DEVIATIONS

GROUP =	nonsite	site	ALL GPS.
VARIABLE			
2 hddw	2787.58911	4015.25781	3677.50024
3 vddw	263.67419	309.06195	295.68884
4 reliefa	201.44240	170.69798	180.82396
5 reliefb	277.57104	227.49187	244.17519
12 pjcover	29.20540	36.72945	34.56460
13 pjeco	1201.90479	979.84430	1053.95557
14 drainage	0.50123	0.71449	0.65562
16 avelev	251.93439	380.16855	345.41327

SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	F VALUE TO ENTER OR REMOVE	NUMBER OF VARIABLES INCLUDED	U-STATISTIC	APPROXIMATE F-STATISTIC
1	12 pjcover		10.0751	1	0.8993	10.075
2	16 avelev		11.3693	2	0.7975	11.303
3	5 reliefb		4.8531	3	0.7558	9.479
4	13 pjeco		5.1774	4	0.7133	8.741
5	3 vddw		0.1997	5	0.7117	6.968
6	2 hddw		0.3067	6	0.7091	5.811
7	4 reliefa		0.2796	7	0.7068	4.979
8	14 drainage		0.1404	8	0.7056	4.329

$permH_2O$ - horizontal distance to nearest permanent water source (solid blueline drainages or springs) as measured on the topographic sheet.

Several computer runs were made with a combination of the original and the added variables, but only the best of these is presented here as our final quadrat model. This model uses ten variables as shown in Table 25 which also presents the means and standard deviations for each variable and shows the stepwise summary table. Ten variables were included in the model with their relative importance shown in the summary table. The model performs about the same as the preliminary quad model with classification rates of 89.6% for non-sites and 77.8% for sites, with 81.5% overall. Jackknifed, these rates are 75.9% for non-sites and 74.6% for sites, with 75% overall. This is the best jackknifed classification rate any of the models achieved at the 0.5 cut level.

Using the 0.4 cut-point increases the classification rate for sites to 81%, but drops non-site rates to 83% for an overall rate of 82%. At a 0.3 cut-point these figures adjust to 86% for sites and 72% for non-sites, with 78% overall. These figures are calculated from posterior probability tables on page 14 of the discriminant print-out (Appendix 4).

In this model the amount of pinyon-juniper cover is the most important variable followed by relief within a 1/2 mi radius, distance to pinyon-juniper ecotone, slope, and so on, with each variable having less influence on the model. This is reflected in the various figures presented in Table 25.

At the 0.5 cut-point 14 quadrats were erroneously predicted to have no sites when, in fact, 19 sites actually are distributed over these quadrats. There are five Fremont sites from four quadrats and six quarry sites from five other quadrats. The remainder are chipping sites except for one, a rockshelter. These misclassifications are similar to those observed for the point-based model, particularly as regards the misclassification of locations with quarries. As with the point based model, quadrats mispredicted tend to be closer to permanant water than the site group but, in contrast to the point model, the elevations of the sites tend to be higher than average. Mispredicted quadrats in this model come mainly from two environmental settings: 1) quadrats predominated by steep slopes, but including benches or mesa rims, and 2) lowland settings with some steeply sloping ground and little or no

Table 25

Final Emery Quadrat Model

Variable group means, standard deviations, and stepwise summary table. Includes 29 non-site quadrats, 63 quadrats with sites.

GROUP =	nonsite	site	ALL GPS.
VARIABLE			
2 hddw	6012.06885	5106.34912	5391.84766
3 vddw	331.31033	330.96826	331.07608
4 reliefa	286.72415	210.31746	234.40218
5 reliefb	480.48276	368.96826	404.11957
12 pjcover	13.79310	38.41270	30.65217
13 pjeco	1324.13794	877.38098	1018.20654
16 avelev	6350.68945	6342.38086	6345.00000
17 drain	2.27586	2.36508	2.33696
18 spl	2.72414	2.12698	2.31522
19 permh2o	11327.58594	11342.85742	11338.04395
COUNTS	29.	63.	92.

STANDARD DEVIATIONS

GROUP =	nonsite	site	ALL GPS.
VARIABLE			
2 hddw	2787.58911	4015.25781	3677.50024
3 vddw	263.67419	309.06195	295.68884
4 reliefa	201.44246	170.69793	180.82396
5 reliefb	277.57104	227.49187	244.17519
12 pjcover	29.20540	36.72945	34.56460
13 pjeco	1201.90479	979.84430	1053.95557
16 avelev	251.93439	380.16855	345.41327
17 drain	1.70915	2.17983	2.04504
18 spl	1.62341	1.21140	1.35309
19 permh2o	7482.58203	7538.51270	7521.15674

SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	F VALUE TO ENTER OR REMOVE	NUMBER OF VARIABLES INCLUDED	U-STATISTIC	APPROXIMATE F-STATISTIC
1	12 pjcover		10.0751	1	0.8993	10.075
2	16 avelev		11.3693	2	0.7975	11.303
3	5 reliefb		4.8531	3	0.7556	9.479
4	13 pjeco		5.1774	4	0.7133	8.741
5	18 spl		3.6111	5	0.6846	7.925
6	19 permh2o		0.4071	6	0.6808	6.641
7	17 drain		0.6427	7	0.6757	5.760
8	3 vddw		0.8226	8	0.6690	5.132
9	2 hddw		1.2315	9	0.6591	4.712
10	4 reliefa		0.0784	10	0.6585	4.201

pinyon-juniper cover. Major site types mispredicted as a result include quarries, and Fremont habitations or camps.

A Comparative Critique of the Final Models

Although both models are similar in variable selection, and in general modelling approach, each model has some distinctive aspects. The quadrat model is designed to characterize a larger piece of ground than the point model, 40 acres as opposed to five or ten acres. It was expected that despite this, the resultant models would be very similar in what variables were important and, in general, how the models functioned. The differences between the models were greater than expected. A comparison of the lists of individual sites mispredicted at the 0.4 level is revealing in this regard. Although 15 sites are misclassified at this level in the final point model, and 16 sites in the quadrat model, only four sites, all of them with quarry components, were mispredicted by both models. None of these have Fremont components although in both models Fremont sites show up somewhat frequently mispredicted relative to their overall rate of occurrence.

One reason for the inability of either model to achieve a high rate of success is this difficulty in dealing with the quarry sites of the area. Quarries tend to occur on steeper slopes than other types of sites and many are found in lowland pediment gravels. This goes against the trend of other site types to be located on gently sloping terrain adjacent to or within pinyon-juniper woodland.

Major Fremont habitations such as Snake Rock Village were mispredicted by one or the other of the models, mainly because they occur at low elevations some distance from pinyon-juniper woodlands. Although a strong pattern in settlement location exists for these types of sites, there are simply not enough of them to influence the model. Either model is good at predicting sites oriented toward utilization of the upland resources of the study area. This utilization pattern is simply so strong that it overwhelms the less frequent site types like habitations and quarries.

A model stratified by elevation, or presence/absence of pinyon-juniper might show better results than the simple random sample approach taken

here, but attempting additional modelling along these lines is beyond the budgetary limitations of this project.

As a final note, the quarry and Fremont habitation mispredictions, taken for either model explain only a part of the failure to perform at high overall levels of accuracy. In each model, a number of other sites, mainly low diversity chipping stations, but also short-term camps and others, were also mispredicted. We have no definite conclusions as to the cause, but some observations may be in order.

After direct experience with a number of discriminant analysis-based models we are: a) amazed that the approach works at all, and b) frustrated by our inability to achieve higher precision (often it appears that a purely subjective model produced by a reasonably gifted archaeologist thoroughly familiar with a study area would be more accurate than extant models such as this one).

The amazement that the modelling approach works as well as it does stems from limitations which are imposed by making the approach simple enough to use. When recording and describing an individual site the survey team makes a multitude of observations about site content and setting; many more variables are observed than are utilized in the model building. Most of these observations can only be made at the site in the field. Specifics of localized soils, immediate local landforms, vegetation patterns and other items can only be made in the field observing things in their modern condition.

It would be extremely time consuming and expensive to include the number of variables which we are capable of making in the field in the broad-scale modelling process. Variables selected must be capable of being generalized over an entire study area if the resultant model is to be useful. If the model is to achieve high prediction rates we would argue that very locality-specific sets of variable measurements will be needed on such things as soil substrate, immediately local shelter quality, vegetation at the sub-community level, proximity to varying qualities of overlooks and proximity to very seasonal water sources, among others. At present we lack a practical method for achieving this sort of precision distribution plotting of a large battery of variables over a large study area.

Appication of the Models to Unsurveyed Lands

Both models can be used to predict the probability of a site(s) occurring at a point, or in a quadrat as the case may be. The method of application is the same for either model--one need only make the variable measurements appropriate to the specific model. The model rates the suitability of a point, or a quadrat as a site location. Eight variables for the point based model, or ten for the quadrat model, are measured as described above to evaluate or measure this suitability. This suitability is viewed as a continuum ranging from very unsuitable on one extreme to very suitable on the other. Suitability is measured as a discriminant or d-score and this d-score is used to place the point or quadrat being measured along the suitability-unsuitability continuum.

In terms of the model variables, a suitable point location is characterized by: higher elevations above drainages defined as water sources and generally higher elevations, more gentle slopes, less relief within 1/4 mi, but greater relief within 1/2 mi, closer proximity to pinyon-juniper and pinyon-juniper ecotones, and slightly greater distances to defined water sources. For the quadrat model a site suitable quadrat is characterized by: greater amounts of pinyon-juniper cover within quad, slightly lower median elevations of the quad, less relief within 1/2 mi of quad center, closer proximity of pinyon-juniper ecotones, and less average slope within quad; other variables are similar for either group.

The scale of measurement used for rating site suitability consists of a numerical scale between the group centroids for the non-site group and the site group. A location's d-score is plotted along this numerical continuum and the position relative to the group centroids provides a measure of site suitability. The mechanics of the model simply involve measuring the variables, using a formula to calculate a d-score, and placing the d-score on the suitability scale. This scale is shown below for each model:

Model	Suitable Group Centroid	0.5 Cut-Point	Unsuitable Group Centorid
Point	-0.35782	0.01431	0.38644
Quadrat	-0.48325	0.28410	1.04982

The d-score to place on this scale is computed by multiplying the raw variable measurement for each variable by its unstandardized discriminent function coefficient and summing these products together with a constant. This process is illustrated below using sample unit 40 West:

Variable	Coefficient		Variable Measurement		Products/ Sum
hddw	0.00009	X	10,000	=	0.9
vddw	- 0.00162	X	998	=	-1.61676
rela	- 0.00054	X	80	=	-0.0432
relb	0.00223	X	740	=	1.6502
pjcover	0.02679	X	80	=	-2.1432
pjeco	0.00047	X	150	=	0.0705
avelev	0.00301	X	7,010	=	21.1001
drain	- 0.18790	X	1	=	-0.18790
sp1	0.56209	X	1	=	0.56209
pH_2O	- 0.00004	X	14,200	=	-0.568
constant	-19.87007			=	-19.87007
			d-score		- 0.14694

This score of -0.14694 places this quadrat in the range between the site suitable group centroid and the 0.5 cut-point, accurately predicting the quadrat as site suitable (it contains seven sites). To use this process for a new quadrat, the coefficients and constant listed above would be used, but measurements for each of the ten variables would have to be made.

The same procedure would be followed for the point model using the coefficients and the constant listed below:

Variable	Coefficient
2 hddw	0.00003
3 vddw	- 0.00257
4 reliefa	0.00318
5 reliefb	- 0.00238
6 grade	0.03279
9 elev	0.00190
11 distpj	0.00078
14 pjeco	- 0.00045
constant	-11.92320

It should be remembered that the numerical space including the group centroids and the space between them is a continuum, and the "cut-point"

for assigning group membership to an unsurveyed case can be adjusted along this continuum. As was discussed earlier, either model achieves greater success at predicting sites at a 0.4 cut-point, but it does so at the expense of more misclassifications of non-site locations as site suitable. When interpreting the d-score for new cases one should bear in mind this aspect of the model and adjust the cut-point for group membership according to the "cost" of misclassification. The 0.5 cut-point classification rates for all of the Emery Tract models are listed in Table 26.

Table 26
Summary of Discriminant Classification Rates

Model	Non-site (Jackknifed)	Site (Jackknifed)	Overall (Jackknifed)
Prefield	62.0% (53.0%)	80.6% (76.9%)	71.6% (65.4%)
70% Interval	74.0% (68.0%)	63.5% (55.4%)	69.5% (62.6%)
Site/Non-site Final	60.0% (59.0%)	62.0% (57.4%)	61.1% (58.2%)
Quad Model	82.8% (69.0%)	82.5% (69.8%)	82.6% (69.6%)
Quad, Reduced Variables	86.2% (79.3%)	73.0% (69.8%)	77.2% (72.8%)
Final Quad	89.7% (75.9%)	77.8% (74.6%)	81.5% (75.0%)

The Elmo Tract Model

No early-stage models were developed for the Elmo Tract because too few sites were previously recorded. This is, in effect, still true since we recorded only six aboriginal sites within the tract boundaries. By adding the lower elevation, more northerly SST data and Class I information from the Elmo area to the Elmo Tract data, we were able to code variables for 36 sites to constrast with 100 random points generated in the same fashion as for the Emery Tract. This model is not based on a random sample and, further, it draws on some sites on the southeast side of Desert Seep Wash near the Price River which are closer to scattered pinyon-juniper woodland than most parts of the Elmo Tract. However, since 100 random points had already been coded we decided to make a discriminant run for the data and see what resulted. The variables used, along with means and standard deviations, are included in Table 27.

Table 27

Elmo Tract Model

Variable group means, standard deviations, and stepwise summary table. Includes 100 non-sites, 36 sites.

VARIABLE	GROUP = sites	nonsites	ALL GPS.
2 hddw	4401.38667	4424.50000	4418.38232
3 vddw	134.16667	96.55000	106.50735
4 reliefa	81.52778	71.05000	73.87353
5 reliefb	123.19444	103.95000	112.72059
6 grade	13.30556	9.99000	10.86765
7 aspecta	97.91666	91.90000	93.49265
9 elev	5633.05560	5538.60010	5563.60303
10 viewqual	57.36111	99.35000	88.23529
11 distpj	8255.55560	18078.00000	15477.94141
COUNTS	36.	100.	136.

STANDARD DEVIATIONS

VARIABLE	GROUP = sites	nonsites	ALL GPS.
2 hddw	3375.78540	3354.52734	3360.09253
3 vddw	115.48965	53.71875	74.93823
4 reliefa	43.79655	36.86107	38.79296
5 reliefb	46.27793	42.86045	43.77383
6 grade	11.68104	9.76543	10.30071
7 aspecta	64.48006	52.52119	55.89220
9 elev	228.38339	84.38750	137.42213
10 viewqual	61.91568	73.45258	70.62128
11 distpj	9815.59190	7822.29199	8388.75391

SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	F VALUE TO ENTER OR REMOVE	NUMBER OF VARIABLES INCLUDED	U-STATISTIC	APPROXIMATE F-STATISTIC
1	11 distpj		36.2917	1	0.7869	36.292
2	9 elev		13.3365	2	0.7152	26.485
3	10 viewqual		2.4688	3	0.7020	18.674
4	3 vddw		1.6354	4	0.6934	14.482
5	2 hddw		1.5370	5	0.6853	11.941
6	6 grade		0.6061	6	0.6821	10.071
7	4 reliefa		0.0273	7	0.6819	8.529
8	7 aspecta		0.0023	8	0.6819	7.405
9	5 reliefb		0.0000	9	0.6819	6.530

The model self-classified non-sites at a 89% rate and sites at a 58.3% rate, for an 80.9% overall classification rate. Jackknifed results are 87% for non-sites, 58.3% for sites and 79.4% overall. While this seems to be a fairly strong model, its specific applicability to only the Elmo Tract is questionable.

Contributions and Contrasts of the Data Base

The abundant data garnered during survey of the Elmo, Emery and Scattered Small Tracts can be profitably compared with the results from previous research in the Castle Valley area. These inventory data can be used to address a variety of topics regarding prehistoric and historic behavior patterns in the region, including chronology and cultural affiliations, site function and seasonality, lithic technology and procurement, settlement systems, extraregional relationships, and paleodemography (e.g., Black et al. 1982, 1984). Each of these issues is discussed below in terms of the results of the present survey and as compared with previous work. Other topics of concern to archaeologists, such as social organization, ritual systems, subsistence strategies and paleo-environmental reconstruction, are more appropriately evaluated using excavation data supplemented by information from large surveys.

The cultural history of the region, as summarized in Chapter 1, has not been appreciably altered by our survey results. Of the 53 sites yielding diagnostic artifacts six have possible Paleo-Indian components, 24 may have one or more Archaic period occupations totalling at least 26 components, and 34 have evidence of Late Prehistoric period (mostly Fremont) occupation; the total number of identified components exceeds the number of sites with diagnostic artifacts because several apparently multiple-component sites are included. The trend for post-Archaic remains to outnumber Archaic and Paleo-Indian components is in keeping with previous work, and none of the cultural complexes represented by diagnostic artifacts in our collection is new to the literature of the northern Colorado Plateau. However, that the Great Basin and Northwestern Plains "culture areas" overlap in this region (particularly during the period 9,000-3,500 BP) is a fact that has been underemphasized by most other researchers (e.g., Schroedl 1976).

The spatial distribution of these dated components is also of interest. Thomas et al. (1981:195-196), Copeland and Webster (1983:69), and Tipps et al. (1984:70-71) all point out that Archaic sites are generally found in more diverse settings than Fremont loci, which are said to be concentrated in streamside and valley margin areas. Holmer (1982:46-52) also notes that site density in general is highest along the west margin of Castle Valley, generally decreasing both to the east and west. Most researchers (e.g., Schroedl and Hogan 1975; Jennings 1978; Thomas et al. 1981; Holmer 1982; Copeland and Webster 1983) repeat Marwitt's (1970) contention that typical San Rafael Fremont sites are clustered on landforms adjacent to watercourses. Table 28 provides a breakdown of locational data for the 66 dated components in our sample. The table shows that sites of all time periods are heavily concentrated in the pinyon-juniper vegetation zone--this corresponds to results from previous work, but it must be remembered that no areas higher than the Upper Sonoran life zone were surveyed in our sample.

Table 28 also confirms that many Fremont sites are relatively close to water, mainly at elevations of 6,000-6,500 ft as has been described by Thomas et al. (1981:195), Copeland and Webster (1983:70, 93) and Tipps et al. (1984:70). However, while streamside settings may be more common for Fremont than for pre-Fremont sites, a large number of the former also can be found in diverse locations far away from major water courses. This dichotomous or dispersed distribution appears to be more characteristic of San Rafael Fremont settlement, and better supports the notion of seasonal sedentism (as opposed to year-round occupancy) as expressed in Chapter 4 by low overall tool diversity at sites, and as noted by Thomas et al. (1981:201), Copeland and Webster (1983:142), and Reed and Chandler (1984:85). Thus, we believe that the settlement descriptions of Marwitt (1970), Schroedl and Hogan (1975), Jennings (1978) and others as applied to the San Rafael Fremont exaggerate the tendency for these sites to be clustered on low landforms next to arable land and water, due to a sampling bias in excavation data toward the larger, later Fremont manifestations.

Our data do show that Archaic sites are more common at higher elevations than Fremont sites, a difference that is not overwhelmingly strong; more significant is that Archaic sites, in contrast to Fremont

Table 28
Correlation Matrix: Environmental Variables vs Dated Components

		Vegetation						Elevation(ft)							Landform						Horiz Dist to Nearest Perm Water				
	PJE	PJ	DS	BS	RP	5-55	55-6	6-65	65-7	7-75	BT	RT	MI	MR	HS	TR	BN	VE	A	B	C	D	E	F
Paleo-Indian	1	4	1	0	0	0	0	3	1	2	0	2	2	1	0	0	0	1	0	0	0	0	0	6
Black Knoll	0	4	0	0	0	0	0	1	2	1	0	0	1	3	0	0	0	0	0	0	0	2	0	2
Castle Valley	0	2	1	0	0	0	2	0	1	0	0	0	0	2	0	0	1	0	0	0	0	2	1	0
Green River	0	9	2	0	0	0	2	5	2	2	0	2	5	2	1	0	1	0	0	0	1	1	1	8
Dirty Devil/ Gen Archaic	0	8	0	0	0	0	1	4	1	2	0	0	2	2	1	0	3	1	0	0	1	2	0	5
Fremont	5	15	7	0	0	0	7	16	3	1	1	3	3	6	0	5	4	5	4	3	5	4	0	11
General Late Prehistoric	0	3	3	0	0	1	1	1	1	2	0	0	1	3	0	1	0	1	0	1	1	1	0	3
Ute/Paiute	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
Totals	6	46	14	0	0	1	13	30	12	10	1	7	14	19	2	6	9	8	4	4	8	13	2	35

Key:

PJE = Pinyon-Juniper Ecotone
PJ = Pinyon-Juniper
DS = Desert Shrub
BS = Big Sagebrush
RP = Riparian
5-55 = 5000-5499
55-6 = 5500-5999
6-65 = 6000-6499

65-7 = 6500-6999
7-75 = 7000-7499
BT = Butte Top
RT = Ridge Top
MI = Mesa Interior
MR = Mesa Rim
HS = Hillslope
TR = Terrace

BN = Bench
VE = Valley Edge
A = 0-99m
B = 100-499m
C = 500-999m
D = 1-1.49km
E = 1.5-1.99km
F = 2km or more

sites, are not generally found clustered along water courses, probably because the Fremont supplemented their diet with domesticated crops grown along these water courses while Archaic peoples did not. Landform data are relatively uninformative except to show that level terrain was favored regardless of geomorphology, and that mesa rims were somewhat more popular--perhaps due to enhanced view quality in such locations. In terms of overall site density, the most consistently cited factors corresponding to high density areas are level terrain and the proximity of pinyon-juniper woodlands. While other environmental variables such as view quality, topographic relief and elevation appear to be of some importance, none of these seem to explain as much about local settlement as slope and vegetation. Yet it is also crucial to realize that not all level landforms in pinyon-juniper areas were occupied prehistorically. For example, Thomas et al. (1981:191) mention that rugged access may be a deterrent to occupation of some wooded areas--a situation we encountered on the Saleratus Benches in unit 124 and, to some extent, on Mesa Butte. In Table 29, average site density within the various surveyed study tracts is compared to the results of the present project.

Extrapolating from our survey data with adjustments made for boundary sites, it can be projected that about 782 prehistoric sites, 73 historic sites and 755 IFs total are in the Emery Tract; and 26 prehistoric sites, nine historic sites and 158 IFs total are in the Elmo Tract (sampling fractions were 10.2% in the Emery Tract and 22.7% in the Elmo Tract). The information from Table 27, in combination with survey data from nonrandom samples such as Berry (1974), Berge (1973, 1974), Sargent (1977), Berge and Nielson (1978), and Holmer (1982), shows that highest site densities in the region are in the Trough Hollow-Molen Reef portion of the Muddy Creek drainage system, with smaller pockets of high site density along other major drainages like Ferron Creek and the San Rafael and Price Rivers. Lowest site densities are in higher elevation zones like the crest of the Wasatch Plateau and Roan Cliffs--where poor ground visibility may contribute to the apparent lack of sites--and in the low elevation shale badlands where trees, tool stone exposures and major water courses are generally absent (e.g., the Elmo Tract and Huntington Planning Unit; this report and Hauck 1979a). As results from the Price River Planning Unit (Hauck 1979a) and Cisco Desert (Bradley et al. 1984) show, however,

and data from the Elmo Tract suggest, overall low site densities in lowland shale zones may mask the occurrence of significant sites crowded

Table 29
Average Site Density Comparisons*

Project	Number of Surveyed Quadrats	Prehistoric Sites	Avg # of sites per 160 ac area
San Rafael Swell 10% Sample (Tipps *et al*. 1984)	68	80	1.18
Central Coal Project Muddy Planning Unit (Hauck 1979a)	22	50	2.27
Central Coal Project Summerville Planning Unit (Hauck 1979a)	15	19	1.27
Central Coal Project Huntington Planning Unit (Hauck 1979a)	10	7	0.70
Central Coal II Tract II (Thomas *et al*. 1981)	31	7	0.22
Central Coal II Area 3 (Thomas *et al*. 1981)	11	101	9.18
Trough Hollow Project (Copeland & Webster 1983)	102.5	65	1.27
Sanpete Tract (Reed & Chandler 1984)	4	9	2.25
Emery Tract (this report)	46	105	4.57 (3.48)**
Elmo Tract (this report)	35	6	0.34**

* - statistics have not been adjusted for "boundary effect" of sites on quadrat boundaries because uniform data are not available for all reports.

** - adjusted densities

along the few large streams which traverse these badlands--i.e., a linear settlement pattern prevails there.

If site density and component frequency are taken as relative measures of prehistoric population levels, highest populations may have been reached in late Fremont times (ca. AD 1000-1200, Bull Creek phase) with those groups concentrated near arable land along major water courses like Ivie Creek, Trough Hollow and Ferron Creek. As mentioned above, many surveys have found a preponderance of Fremont sites in those cases where diagnostic artifacts have been discovered. Our data also suggest that relatively high population levels may have been reached during the late subphase of the Green River phase or the subsequent Dirty Devil phase, based on the large number of Gypsum and medium-sized Elko points in the collection (Schroedl 1976; Holmer 1978). The hiatus postulated by Madsen and Berry (1975) for the Dirty Devil phase has been contradicted by more recent data (e.g., Hauck and Weder 1982; Martin et al. 1983). Perhaps population levels gradually rose to their late Fremont peak beginning ca. 4,700-4,500 years ago at the end of a cool and/or moist climatic episode corresponding to the first stade of Triple Lakes glaciation (Benedict 1981).

The range in site types observed in the three study tracts is no different than that defined by previous research, albeit different terminology may be employed. Only rock art sites were less frequent than expected, being limited to a single location within surveyed units (Snake Rock Village) but such sites are more common in the region as a whole. However, the range in activities represented at habitations and camps was also narrower than expected even though those two site types were present in some numbers. That is, overall tool diversity was so low at most such sites that relatively brief occupations involving a narrow range of activities are probably represented, and little evidence of year-round sedentism was found at most Fremont habitations as previous work had shown. While recent surveys have noted the seasonal nature of local Fremont settlement (e.g., Reed and Chandler 1984:85), the earlier notion that "typical" San Rafael sites are found in valley settings--and contain "abundant" Anasazi trade ware--should be discarded. To be sure, such site clusters do exist along major streams like Trough Hollow, but also

numerous are small Fremont sites dispersed throughout the Upper Sonoran life zone and located far from major drainages.

Extraregional relationships appear to have been fairly limited throughout prehistory in the Castle Valley area. Very little obsidian was found--in keeping with the results from previous work--and imported ceramics were likewise uncommon, as has been stressed before. As one would expect, Fremont sites contain the most evidence for contact with outside groups: obsidian was found in association with ceramics at 42EM2045 and 2065; Anasazi trade ware was noted at 42EM2065 along with the obsidian; a shell tinkler or bead was recovered from Fremont site 42EM2043 that may be derived from the Gulf of California area; and non-local Fremont ceramics (Snake Valley and Promontory types) are present at four sites, including Snake Rock Village. These data suggest strongest contacts were with neighboring groups to the south and west. The presence of "Plains" projectile point types in this area, particularly during late Paleo-Indian (Plano) and early Green River phase times, more likely relates to actual occupation by groups characterized by these point types rather than being an indication of trade or "influence" from the Plains (cf. Aikens 1966; Schroedl 1976).

Finally, our survey data identified a large number of tool stone procurement (quarry) sites dispersed over a large portion of the central and southern sections of Castle Valley. Others have also made note of this fact (e.g., Berge 1974; Holmer 1982; Thomas et al. 1981), but underemphasized has been the effect such outcrops had on local settlement patterns. For instance, most researchers rightly point to the pinyon-juniper woodlands as containing the largest percentage of archaeological sites in the region. Yet, most pediment gravel exposures containing knappable tool stone nodules that our survey located were in the desert shrub vegetation zone (especially shadscale and grassland associations), or on relatively steep hillsides (see Tables 10 and 16, and Figure 10). Quarries thus account for over a third of all sites recorded in desert shrub areas of the Emery and Scattered Small Tracts, and for more than half of all sites found on slopes exceeding 8-10°. In accordance with the material types present at such outcrops, chalcedony and chert dominate in local collections (Chapter 4, this report; Thomas et al. 1981:149-151; Hauck and Weder 1982:124-125; Copeland and Webster 1983:54; Reed and

Chandler 1984:31). In sum, quarries explain much of the variability seen in the settlement patterns of the Castle Valley, and constitute a significant aspect of prehistoric adaptive strategies that cannot be ignored.

Site Significance Evaluations

The legal framework upon which the present study is based has been outlined in Chapter 1, and most recent contract reports present cogent discussions regarding how prehistoric and historic sites were evaluated relative to the National Register (e.g., Black et al. 1982:134-148, 1984: 144-151; Holmer 1982:29-33; Copeland and Webster 1983:117-128; Tipps et al. 1984:74-77; Reed and Chandler 1984:50-56). It used to be accepted practice for archaeologists to judge the significance of sites based on their size and complexity, with the result (perhaps intended) that most "open lithic scatters" were written off as insignificant while most Formative stage sites with evidence of features or Paleo-Indian manifestations were deemed worthy of further work. More recently, however, a much more balanced approach has become commonplace in which the potential of a site to yield important data beyond that garnered during survey is crucial to the significance evaluation, regardless of its age or affiliation. Thus, for example, a Late Archaic period chipping station without features or large numbers of tools might be eligible for the NRHP if it contained an intact, buried component with abundant data on local lithic technology patterns.

While the exact criteria employed in significance evaluations may vary between institutions and individuals (e.g., contrast Holmer [1982] with Reed and Chandler [1984]), most archaeologists agree that the quantity and quality of cultural material present is more important than the nature of those preserved materials (there are obvious exceptions to this general statement). Intact, buried cultural material is generally evaluated significant regardless of cultural affiliations (ibid.); in effect, few archaeological sites are evaluated eligible for the NRHP based on surface evidence alone, although such evidence is almost exclusively used in evaluating Historic period Euro-American sites (only one of the fourteen Euro-American sites located in the three study tracts has been evaluated eligible for the NRHP; i.e., 42EM2064). As implemented by most

archaeologists in the region, prehistoric aboriginal sites are assessed as insignificant cultural resources unless the possibility exists for in situ buried cultural material, or unless surface evidence can contribute to answering specific research questions.

Those evaluated significant on surface evidence are generally exceptional in exhibiting: a) extremely voluminous, diverse and/or ancient cultural debris at the present ground surface; b) unusual or unique artifacts, features, etc. such as rock art; or c) clear-cut evidence of abundant buried remains as in an arroyo exposure (Metcalf and Black 1984:3-4). Two such sites in the project area, Snake Rock Village at Fremont Junction (Gunnerson 1957a:109-115; Aikens 1967) and 42EM2066 west of Ferron (Figure 8), have been evaluated eligible on present evidence alone and Holmer (1982:30) provides a listing of other sites in the region already on the NRHP and Utah State Register. Of the remaining 140 sites in the three study tracts, 62 are evaluated potentially eligible for the NRHP and 78 are ineligible (Tables 11 and 17).

Our procedure in determining which sites might contain significant information worth preserving at the present time was to combine our field assessment of the potential for intact buried material at each site, with the results from completion and synthesis of all laboratory analyses regarding feature morphology, site characteristics relative to contemporary research questions (e.g., Holmer 1982; Copeland and Webster 1983), degree of natural and man-made disturbance, and presence/absence of unique artifacts or features. Thus, as outlined in the criteria for NRHP eligibility set forth in 36CFR Part 60.6, the most often-used criterion in evaluating prehistoric sites--the most common cultural resource within the study area--was 36CFR 60.6d: significant sites are those "that have yielded, or may be likely to yield, information important in prehistory or history."

Those 78 sites that have been evaluated not eligible for the NRHP were so assessed because the probability of buried material was low, surface materials were limited in quality and quantity, and all pertinant relevant data have been collected. Therefore, there is little or no potential for yielding significant data. Similarly, 13 of 14 Historic period Euro-American sites have been evaluated not eligible for the NRHP due to lack of architecturally significant structures, low probability of buried

material, surface remains limited in quality and quantity, and lack of additional data significant to the local culture history. The single paleontological site recorded is evaluated ineligible because of the low quality of fossils present, not their quantity or the species they represent. All isolated finds are inherently insignificant resources that are ineligible for the NRHP.

In terms of management recommendations, no further work is necessary for the IFs or the 78 ineligible sites. Avoidance is the primary recommendation for the remaining 65 sites, although in a few cases (e.g., 42EM2062) it would be preferable to salvage the contents of features in an active state of erosion. If avoidance is not possible for whatever reason, the 62 potentially eligible sites should be test excavated, surface remains should be mapped in detail, and/or representative collections of surface artifacts should be made. The results of such preliminary work would then determine what further course of action might be necessary, if any; development of a mitigation plan incorporating a project-specific research design should follow any program of evaluative, limited testing (Schiffer and Gumerman 1977; Scovill et al. 1977; Nickens 1980). Recommendations for the three eligible sites in the study area--42SV5, 42EM2064 and 42EM2066--are considered in more detail below for each cultural resource.

Site 42SV5, Snake Rock Village, already has been subjected to both testing (Gunnerson 1957a) and full-scale excavation (Aikens 1967). This work identified 31 prehistoric Fremont structures, petroglyphs (Figure 22), and an abundance of chipped stone, ground stone, ceramic, bone and perishable artifacts; it is one of the type sites for Ivie Creek Black-on-White pottery (R. Madsen 1977:35). Thus, the site is eligible for the NRHP because it is an exemplary locus of Fremont occupation with well-preserved features and artifacts representative of a variety of activities over an extended period of time. Even though a great deal of excavation work has been completed there, the research was conducted long ago (1956-57 and 1964) and only a small percentage of the known site area was dug (ca. 528 of 17,671 m^2, or about 3%). The site should be placed on the National Register based on our present knowledge of it, but if local developments threaten it in the future, more excavation should be done using modern methodologies and a multi-disciplinary research team.

FIGURE 22

Close-up view looking north at "Snake Rock" petroglyph at 42SV5, taken in August, 1984. Compare with Aikens (1967:Fig. 2), noting that a smaller boulder at the lower left side of the rock art panel has been moved. Roll MA-24-84, neg. #18.

View looking northeast at barn behind house at 42EM2064 in Emery. Roll MA-55-83, neg. #22.

FIGURE 23

Site 42EM2064 is a Historic period habitation, barn and associated outbuildings on the northwest edge of the town of Emery. There is the potential for buried cultural material in the ruins of the outbuildings and associated trash concentrations at this site, and both the house and barn were standing at the time of our survey. Artifactual and archival data indicate the site was initially occupied in the late 19th century, with abandonment within the past 25 years. The site is evaluated eligible for the NRHP based primarily on the architectural significance of the barn (Figure 23), as an intact example of early ranch structures in the Emery area. The architectural significance of the site is enhanced by the potential for buried historical artifacts and features, which may shed light on activities carried out in the early Historic period of Emery. Our initial recommendation is that a detailed mapping and documentation study of the house and barn should be done as soon as possible, due to the frail condition of the latter. In addition, if it is determined that either of these standing structures warrant upkeep or have visitation potential, we strongly recommend that the barn be stabilized soon to prevent its collapse. Finally, if the outlying feature ruins and trash are threatened by further impacts, text excavations should be conducted in those areas to determine the integrity of any buried deposits present, and to determine what further course of action might be necessary if intact buried material is preserved here.

The Bailey Butte Site, 42EM2066, is a complex Fremont habitation on a prominent butte west of Ferron (Figure 8). It is well-known to locals, and some disturbance of the archaeological deposits has taken place. Artifacts are present on the slopes and benches surrounding the butte, but the primary occupation zone lies atop the butte where four depressions mark probable pithouse structures and one other dry-laid masonry surface structure is present. The site is evaluated eligible for the NRHP based on the abundance and variety of artifacts present, the occurrence of intact habitation and storage structures, and its interpretive potential regarding regional Fremont culture history. Avoidance is the primary recommendation but, if further vandalism occurs, salvage of the buried features should take place before too much information is lost. If development or other impacts (e.g., a land exchange) should threaten the area, then full-scale excavation using a multi-disciplinary team within the framework of a site-specific research design should be undertaken.

Chapter 6

Summary and Conclusions

The Survey

Between October 24, 1983 and October 13, 1984 MAC completed an archaeological inventory of 8,880 acres in three study tracts within the Castle Valley locality of central Utah. The survey had a dual purpose: to provide data on cultural resources within dispersed parcels of BLM land being considered for possible "realty actions"; and to produce a predictive model or models of site location within two blocks of BLM land, as a management tool and planning document in advance of "coal-related development". In sum, this inventory work resulted in the discovery and recording of 134 sites and 143 IFs overall, plus 127 previously recorded sites in the southernmost study tract.

During the 1983 field season the Scattered Small Tracts were inventoried (Figure 3). Intensive survey was completed within 25 separate parcels ranging between 40 and 320 acres in size, and totalling 2,400 acres. Twenty-six previously unrecorded sites--including one Historic period habitation and one paleontological site--and thirty IFs were recorded. Two of the 26 sites, the historic habitation at Emery (42EM2064) and a Fremont habitation near Ferron (42EM2066, the Bailey Butte Site), have been evaluated eligible for the NRHP based on present evidence and seven other prehistoric aboriginal sites are potentially eligible. Fifteen of the 26 sites are aboriginal resources of unknown age or affiliation, five are Fremont, three have possible Archaic components, and one each are of Ute, Historic Euro-American, or paleontological derivation. Site types represented include four habitations, eight short-term camps (one with rockshelters), eight quarries (one at a habitation), six low-diversity chipping stations and one locus of marine invertebrate fossils.

The following year a sample inventory was conducted within the remaining two study tracts. In the northern portion of Castle Valley, the Elmo Tract was surveyed at the 20% level of intensity (Figure 2). A total of 2,800 acres within the 14,000 area block was investigated via a random sample of 35 eighty-acre units oriented east-west. Eight previously unrecorded sites and 36 IFs were identified, including two Historic period sites, five aboriginal sites of unknown age or affiliation and one prehistoric site dating to the Late Prehistoric period. Only two IFs

suggest a pre-Formative Archaic occupation of the study tract. Three of the six aboriginal sites are potentially eligible for the NRHP, and the remaining five sites are ineligible. Five short-term camps are present--including both Historic period sites--as well as two low-diversity chipping stations and one possible faunal processing locus. Locational data from the six aboriginal sites in the Elmo Tract were combined with those from the nine prehistoric sites in the SSTs within the desert shrub zone, and from 21 other previously recorded sites in the Elmo area to produce a tentative predictive model of surprising accuracy (see Chapter 5).

In the southern end of Castle Valley lies the 37,000 acre Emery Tract (Figure 4). Ten percent of the land area in this block was sampled for cultural resources via inventory of 46 randomly selected, east-west oriented 80 acre units totalling 3,680 acres. By far, the highest site density in the region was encountered in this tract as 100 sites and 77 IFs were recorded for the first time, seven sites were re-recorded and 120 other previously recorded sites were identified (two in our sample units: 42EM152[?] and 42EM770). Of the 109 sites in surveyed units 99 are prehistoric aboriginal, four are Historic period Euro-American, and six have both prehistoric and historic components. Among the prehistoric resources are six possible Paleo-Indian components, 21 possible Archaic components, 22 Fremont components, five other Late Prehistoric period components of unknown affiliation, and 62 aboriginal sites of unknown affiliation or age. The IF data also reflect substantial occupation of the tract during Archaic and Fremont times, and provide the only evidence in our survey for a Ute presence there. In terms of significance one site, Snake Rock Village (42SV5; Figure 22), is evaluated eligible based on present evidence, 52 sites are potentially eligible and 56 are ineligible.

Within the surveyed Emery sample units are fourteen habitations (one with rock art), 34 short-term camps, nine medium-diversity chipping stations, 37 low-diversity chipping stations, three trash dumps and two fence lines. These data, at times supplemented with locational information from previously recorded aboriginal sites in the study tract, were used to produce and refine models of settlement location in two forms. Our efforts to improve the results of a point-based model failed, while our quadrat-based model was refined with more success (see below).

Thus, our experience with a quadrat model outperforming a point model parallels that of the Tar Sands Project (Tipps et al. 1984; Schroedl 1984).

The results of our work show that level terrain within pinyon-juniper woodlands contains the highest number of sites, as previous work had indicated. View quality also seems to have been of some importance, as suggested by the relatively large number of sites on mesa rims and on slopes exceeding ten degrees. Conversely, sites were not clustered close to water sources in the Emery Tract, as all three variables related to this issue--elevation, horizontal and vertical distance to defined water--indicate that a dispersed settlement pattern throughout the Upper Sonoran life zone prevailed. Related to this apparent pattern are the large number of permanent water sources in the southern portion of Castle Valley, the corresponding abundance and diversity of economic plant and animal species present, the availability of abundant knappable tool stone, and low winter snowfall amounts in the shadow of the Wasatch Plateau. These factors combined to render the area very suitable for aboriginal occupation, both via hunting and gathering and, especially after AD 950 (Euler et al. 1979), via maize horticulture.

The "linear" settlement pattern exhibited in areas where sites are clustered along drainage systems can be said to exist in the Emery Tract only during late Fremont times. While Fremont sites post-dating AD 950-1000 undoubtably occur in upland areas, most excavated sites in the region are villages located near water and arable land, that are both larger than the average Fremont settlement and contain evidence for occupation late in the Formative era. We hypothesize that salubrious climatic conditions after AD 950 led to a moderate settlement shift toward fewer, larger villages in valley margin settings by enhancing the productivity of maize fields. The resultant surpluses both allowed the population to grow further, and created a need for the surface coursed-masonry storage structures seen at some sites. Outside contacts also were expanded at this time, as suggested by more numerous trade items such as Anasazi ceramics, obsidian and shell from the Gulf of California, as well as by decorated San Rafael Fremont ceramics. These data, in combination with the regional radiocarbon chronology (Table 2), lead us to advance a three-stage phase sequence for the post-Archaic period in Castle Valley:

Protoformative phase, AD 150-700; Muddy Creek phase, AD 700-1000; and Bull Creek phase, AD 1000-1200.

Settlement patterns in the Elmo Tract and northern SSTs reflect the greater aridity and lack of tree cover in that area, with the few sites within the desert shrub zone located either at tool stone outcrops (as in the SSTs), near the Price River, or along the lower courses of major Price River tributaries like Marsing, Mathis, Desert Seep and Washboard Washes. The Price River, in addition to being the only large, non-saline permanent water source in the Elmo Tract, has the added attraction of flowing through a significant zone of pinyon-juniper woodlands just east of the tract and below its confluence with Washboard Wash. Thus, the linear settlement pattern approached in late Fremont times further south is more strongly expressed in the Elmo Tract, although proximity to pinyon-juniper forest continues to be an important factor.

During the Archaic period in the Valley (ca. 8,300-1,800 BP) a dispersed settlement pattern was characteristic, even more so than during the Formative era since other surveys (e.g., Berge and Nielson 1978; Copeland and Webster 1983; Reed and Chandler 1984) have shown that Archaic sites outnumber Fremont sites in settings above the Upper Sonoran life zone. Both Plains and Great Basin cultures occupied the northern Colorado Plateau prehistorically, with a very substantial Basin-related occupation in the Castle Valley area during the Black Knoll phase (Schroedl 1976). Later assemblages show more Plains characteristics, albeit Basin-Plateau diagnostics still predominate; the Green River may be a useful demarcation line for the northern Colorado Plateau, with Northwestern Plains-Wyoming Basin complexes dominant to the east and Basin-Plateau complexes dominant to the west (ibid.).

Interestingly, the Castle Valley area is one where the effects of the Altithermal climatic episode are obvious, not conjectural. Only Sudden Shelter has deposits clearly dated between 6,200 and 5,000 BP, and no radiocarbon dates whatsoever fit in that time period. It may be partially true that the Wasatch Plateau was an Altithermal "refuge" (Copeland and Webster 1983; cf. Benedict 1979), but equally important is that the period in question was one of erosion, not deposition, and site preservation is therefore poor for Castle Valley phase components (Schroedl 1976:63-64). During the Altithermal, which apparently climaxed around 5,700 BP, Archaic

groups may have settled either at higher elevations or closer to permanent streams at the lower elevations. In both cases, the chances for site burial are enhanced and site visibility suffers; we found very few Castle Valley phase diagnostics during our survey.

Finally, the evidence for a Paleo-Indian occupation in the region was sparse in our survey, but not uninformative. Most interesting is that three of the six sites with possible Paleo-Indian artifacts occur at medium-diversity chipping stations, a relatively rare site type. Functionally, these sites are something of a mystery but multiple activities are suggested. Also, the tendency for Paleo-Indian sites to be located on landforms with good overviews of water sources (see Chapter 1) applies to three of six sites and one IF. It would be an understatement to say that more work needs to be done regarding Paleo-Indian adaptive strategies on the northern Colorado Plateau.

Modelling Summary

Seven models have been run for the Castle Valley data set, one for the Elmo Tract, and the others for the Emery Tract. The Elmo model and the earlier two increment models for Emery are based on contrasting locations where sites occur with 100 "random points" distributed across the study area. For Emery the initial, or pre-field, model was used to make predictions for 46 test cases which were measured from half of the units selected for survey. Interpreted literally, the results of this model were an utter failure. However, if one interprets the model as being correct if it predicts site proximity rather than exact locations, it worked reasonably well.

An interim, point-based model was run on approximately 70% of the field data and the results were compared with the results of the pre-field model. The resulting model showed no improvement even though it drew on a more nearly random sample. A final point-based model using a 100% sample was very similar in performance.

Two quadrat-based models were also run, both on a complete data set. The initial version of the model used slightly different variables, and ways of measuring variables than the final quadrat model, but the results were about the same, approximately 81% overall classification rates.

The data set for Elmo is so meager that a statistically defensible model cannot be generated. The model presented in this report is really only intended to guide future work. Perhaps with an expanded data base a workable model would be possible.

Appendix 1

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Appendix 2

Site and IF Data

Appendix 2-1
Site Data-Elmo Tract

Permanent Site #(42-)	Temporary Site #(MZ-)	USGS Quad Map	Site Area(m^2)	Tool Classes Present	Features Present	Suggested Affiliation/Age
CB447	2201	OR	1	0	1 hearth	unknown
448	IF-19-1	OR	200	TC,ME,WD	1 hearth, 1 stone ring	Historic
EM1981	2002	OR	165	UB,MF	none	unknown
2052	2202	OR	1,414	0	none	unknown
2053	2203	OR	1,257	PP	4 hearths	Late Prehistoric
2054	2204	OR	235+	MM,BB	2 hearths	unknown
2055	2205	OR	79	0	none	unknown
2081I	IF-87-1	OR	100	GL,TC,WD,ME	1 hearth	Historic

Appendix 2-2
Site Data-Scattered Small Tracts

Permanent Site #(42-)	Temporary Site #(MZ-)	USGS Quad Map	Site Area(m^2)	Tool Classes Present	Features Present	Suggested Affiliation/Age
EM2056	1219	CD	62,832	0	none	unknown
2057	1220	FE	78,540	FS	none	unknown
2058	1221	FE	393	UC	none	unknown
2059	1222	FE	141	PP,UC	none	unknown
2060	1223	FE	1,374	CE,UB,MF,FS,MH	none	Fremont
2061	1224	FE	141	0	none	unknown
2062	1225	FE	361	CE,MM,UC	1 hearth	Fremont
2063	1228	CD	350,000+	PP,MF,UC	none	Mid-Late Archaic
2064	1230	EW	19,085	GL,ME,NW,CE,LE, WI, TC, WD	house, barn, root cellar, dump, ditch, fence, orchard	Historic
2065	1231	EW	9,012	PP,UB,CE,GL	2 rockshelters w/ walls	Fremont & Historic
2066	1238	FE	7,854	CE,PP,UB,BK,MH	4 pithouses, 1 surface masonry structure	Fremont
2067	1229	EE	6,597	MF	1 cobble cluster	unknown

Appendix 2-2 (continued)

Permanent Site #(42-)	Temporary Site #(MZ-)	USGS Quad Map	Site Area(m^2)	Tool Classes Present	Features Present	Suggested Affiliation/Age
EM2068	1331	EE	78,540	CE,PP,UB,UU, MF, MH, MM	12 hearths & middens	Fremont
2069	1336	EE	16,965	PP,FS,UC	none	Archaic/Fremont-Elko knife
2070	1337	EE	3,888	PP,UU,UB	2 hearths	Early-Mid Archaic
2071	1338	EE	59	0	1 hearth	unknown
2072	1340	EE	4	0	1 hearth/rock alignment	unknown
2073	1339	EE	10,053	UU,UC,MH	5 hearths	unknown
2074	1534	HH	2,749	MF	none	unknown
2075	1535	HH	471	UC	none	unknown
2076	1536	HH	1,414	0	none	unknown
2077	1537	HH	259,181	0	none	unknown
2078	1226	EE	28,628	PP,UB,UU,MH	8 hearths, 2 middens	unknown
2079	1227	EE	864	PP,MM	4 hearths	Ute
2080	1332	EE	48,381	0	none	unknown
2082	---	HU	7,000	marine invertebrate fossils	none	Cretaceous (Santonian)

Appendix 2-3
Site Data-Emery Tract

EM152	---	WF	7	0	1 pole & rock frame	Historic
669	2039	WF	785	CE	2 rockshelters	Fremont
770	2051	WF	14	MH,MM,ME	none	unknown prehistoric, Historic
1256	2236	MB	20,617	UB,UC,PP,HS,BS	none	Archaic?-Elko pt
1982	2003	EE	12,252	FS,MF,CE	1 burned rock scatter	Fremont
1983	2004	EE	785	0	none	unknown
1984	2005	EE	1,767	0	none	unknown
1985	2006	EE	3,574	UB	2 hearths	unknown
1986	2007	EE	1,473	PP	none	unknown

Appendix 2-3 (continued)

Permanent Site #(42-)	Temporary Site #(MZ-)	USGS Quad Map	Site Area(m^2)	Tool Classes Present	Features Present	Suggested Affiliation/Age
EM1987	2008	MB	440	PP	none	Archaic?-Elko
1988	2009	MB	7,461	PP,UB	none	Late Paleo-Indian pt
1989	2010	EE	2,886	BS,BT	none	unknown
1990	2011	EE	1,047	FS,BS	none	unknown
1991	2012	EE	2,200	UB,PP	none	unknown
1992	2013	MB	3,220	UB,PP,MF	none	Late Paleo-Indian
1993	2014	MB	12,174	UB,PP	none	Archaic & Late Prehistoric
1994	2015	MB	400	0	none	unknown
1995	2016	MB	5,498	PP	none	Archaic?-Elko pt
1996	2017	MB	23,758	PP,UB,MF	none	Mid-Late Archaic, Late Prehistoric
1997	2026	MB	7,422	UB	none	unknown
1998	2027	MB	50,894	HS	none	unknown
1999	2030	MB	196	CE,UB	none	Fremont
2000	2031	MB	134	MF	none	unknown
2001	2032	MB	1,991	UB,HS	1 hearth	unknown
2002	2033	MB	3,300	CE	1 hearth	Fremont
2003	2034	MB	118	HS	1 hearth	unknown
2004	2035	MB	133	CE	1 burned rock scatter	Fremont
2005	2036	MB	3,848	CE,MF	1 hearth, 2 middens	Fremont
2006	2037	MB,EE	412,334	CE,UB,HS, PP,MF	3 rockshelters, 1 burned rock scatter	Late Paleo-Indian? Mid-Late Archaic, Fremont
2007	2038	WF	1,414	UB	2 burned rock scatters	unknown
2008	2040	WS	22,619	HS	none	unknown
2009	2052	WF	79	UC	none	unknown
2010	2053	WF	118	PP,UC	none	Archaic
2011	2054	WS	4,006	UB,FS,PP,DR,GR	none	Early-Mid Archaic
2012	2055	WF	39	0	1 hearth	unknown
2013	2056	WF	412	UB	1 hearth	unknown
2014	2064	WF	6	MM	1 burned rock scatter	unknown
2015	2065	WF	1,382	FS,UB,MF	3 hearths	unknown

Appendix 2-3 (continued)

Permanent Site #(42-)	Temporary Site #(MZ-)	USGS Quad Map	Site Area(m^2)	Tool Classes Present	Features Present	Suggested Affiliation/Age
EM2016	2066	WS	318	PP	none	Late Prehistoric
2017	2119	MB	143	0	none	unknown
2018	2120	MB	94	0	none	unknown
2019	2121	EE	200,000+	PP,DR,MM, HS,UB,FS	2 hearths, 1 burned rock scatter	Archaic
2020	2122	MB	1,374	0	none	unknown
2021	2123	MB	141	0	none	unknown
2022	2124	MB	56,077	PP,HS,UB	none	Early Archaic
2023	2150	MB	393	0	none	unknown
2024	2151	MB	43,982	PP,UC,UB,FS,MF	none	Paleo-Indian, Middle Archaic
2025	2152	MB	157	UC	none	unknown
2026	2153	MB	38,170	PP,UB,HS,MF,DR	none	Early/Archaic
2027	2154	EE	912	UB	none	unknown
2028	2155	EE	4,320	UB	none	unknown
2029	2156	MB	196	UB,UC	none	unknown
2030	2157	MB	2,356	0	none	unknown
2031	2158	MB	23,091	UB,MF,CT	none	unknown
2032	2159	MB	3,770	PP,FS,BK	none	Late Paleo-Indian
2033	2212	WF	31,102	CT,BT,MH,MF	2 hearths, 2 cairns	unknown
2034	2213	WF	22,619	MM,MH,MF	10+hearths/middens, 1 rubble mound	unknown
2035	2214	WS	5,655	UC,MF	1 hearth (buried)	unknown
2036	2215	WS	2,356	FS	none	unknown
2037	2220	WF	3,142	0	none	unknown
2038	2226	WF	6,126	UB,CE,UC	1 hearth, 1 midden	Fremont
2039	2227	WF	1,178	HS	none	unknown
2040	2228	WF	503	UB,BS,MF	none	unknown
2041	2229	WF	1,414	0	none	unknown
2042	2230	EE	78,540	CE,BK,UB	8 hearths/middens, rockshelters	Fremont

Appendix 2-3 (continued)

Permanent Site #(42-)	Temporary Site #(MZ-)	USGS Quad Map	Site Area(m^2)	Tool Classes Present	Features Present	Suggested Affiliation/Age
EM2043	2231	EE	56,549	CE,SL,UB,MF,PP	none	Paleo-Indian, Fremont
2044	2232	EE	801,106	CE,PP,RS,FS	1+ hearth	Middle Archaic, Fremont
2045	2233	EE	21,991	GL,TC,CE, UB,BS,MF	5 hearths	Fremont, Historic
2046	2234	EE	707	UB,BS	none	unknown
2047	2235	MB	54,978	CE,PP,UB,BS, HS,UC,MH,FS	2 hearths	Mid-Late Archaic, Fremont
2048	2237	EE	500,000+	UB,BS,FS,GL, ME,TC,CE	5+ hearths	unknown prehistoric, Historic
2049	2238	MB	1,367	0	none	unknown
2050	2239	MB	5,184	CE,MM	2 hearths	Fremont
2051	2240	MB	4,618	CE,MM	4 pithouse? depressions	Fremont
SV5	2028	WF	17,671	CT,BK,FS,PP,DR MF,SP,MH,MM,OG BB,CE,SL,WD	35+ structures & hearths	Fremont (Snake Rock Village)
438	2045	WF	12,959	GL	5 burned rock scatters	unknown prehistoric, Historic
439	2047	WF	14,726	PP,DR,UB,MM	3 burned rock scatters	Archaic/Fremont-knife
440	2048	WF	5,890	MM	2 burned rock scatters	unknown
474	2216	WS	194,386	CE,PP,UB,CT,MH	2 hearths	Early Archaic, Fremont
2033	2018	WF	34,361	PP,CE	3 hearths	Mid-Late Archaic, Fremont
2034	2019	WF	13,744	PP,UB,MH	9 middens, 1 hearth	Late Prehistoric
2035	2020	WF	1,237	UB	1 hearth	unknown
2036	2021	WF	200	0	1 brush fence	Historic
2037	2022	WF	225	0	1 wood lean-to	Historic
2038	2023	WF	687	HS	none	unknown
2039	2024	WF	141	0	none	unknown
2040	2025	WF	1,060	0	none	unknown
2041	2029	WF	325	0	1 wood fence	Historic
2042	2046	WF	38,485	MF	2 burned rock scatters	unknown

Appendix 2-3 (continued)

Permanent Site #(42-)	Temporary Site #(MZ-)	USGS Quad Map	Site Area(m^2)	Tool Classes Present	Features Present	Suggested Affiliation/Age
SV2043	2049	WF	2,985	MM,CE	2 burned rock scatters	Fremont
2044	2050	WF	7,069	UB,FS	6 burned rock scatters	unknown
2045	2060	WF	9,032	PP,UC,GL,ME, WI,TC,AM,WD	none	Early Archaic, Historic
2046	2061	WF	1,512	PP	none	Late Prehistoric
2047	2062	WF	942	MH,UC	none	unknown
2048	2063	WF	1,210	PP,UB,MF	none	Mid-Late Archaic
2049	2206	WF	1,414	MF,UC	none	unknown
2050	2207	WF	4,339	CT	none	unknown
2051	2208	WF	707	UB	none	unknown
2052	2209	WF	1,257	MF	none	unknown
2053	2210	WF	5,969	UB,FS,MF,MM, MH,CE,TC,WD	none	Fremont
2054	2211	WF	4,241	UB,BS,MM,MH,	none	unknown
2055	2217	WS	2,356	UB,HS	2 middens	unknown
2056	2218	WS	22,462	BS,FS,UC	none	unknown
2057	2219	WS	2,513	UB	none	unknown
2058	2221	WS	236	CE,MH,UB, MM,UC	1 hearth	Fremont
2059	2222	WS	11,310	UB,BS,MF,FS, UC,MM,BK,MH	none	unknown
2060	2223	WS	22,619	UB,FS,PP,MF, UC,MM	none	Archaic?-Elko pt
2061	2224	WS	1,257	UB,FS	none	unknown
2062	2225	WS	70,686	CE,PP,CT,MF, UC,FS,MM,MH, UB	5 hearths/middens	Middle Archaic, Fremont

Appendix 2-4
Isolated Find Data-Elmo Tract

IF Number	Quad Map	Features/Artifacts	Suggested Affiliation/Age
ELIF-1-1	OR	1 arrow pt	Late Prehistoric
21-1	OR	1 chert flake	unknown
27-1	OR	1 chert flake	unknown
27-2	OR	1 arrow pt blade, 1 modified flake	Late Prehistoric
31-1	OR	1 modified flake	unknown
37-1	OR	1 chalcedony flake	unknown
37-2	OR	2 modified flakes	unknown
37-3	OR	1 modified flake	unknown
37-4	OR	trash dump	Historic, 1880-1930s
41-1	OR	1 reworked proj pt/scraper	Archaic?-Elko style
41-2	OR	1 bifacial preform	unknown
50-1	OR	1 proj pt blade	Archaic?
51-1	OR	1 quartzite flake	unknown
58-1	OR	1 biface frag	unknown
58-2	OR	1 chert flake	unknown
61-1	EL	4 tin cans, 1 purple bottle (frags)	Historic, 1880-1915
73-1	OR	1 proj pt tip	unknown
73-2	OR	trash, 10 x 10m	Historic, 1880-1915
80-1	EL	1 hearth, purple glass	Historic, 1880-1915
86-1	EL	purple glass	Historic, 1880-1915
86-2	EL	3 prospect pits (gravel/clay?)	Historic
86-3	EL	purple glass flask	Historic, 1880-1915
94-1	OR	1 modified flake	unknown
109-1	OR	1 quartzite flake	unknown
109-2	OR	purple glass	Historic, 1880-1915
109-3	OR	1 modified flake	unknown
120-1	EL	1 chert flake	unknown
121-1	EL	purple glass	Historic, 1880-1915
130-1	OR	1 chert flake	unknown
130-2	OR	purple glass catsup bottle frags	Historic, 1880-1915
135-1	OR	1 oolitic chert flake	unknown
135-2	OR	1 chalcedony flake	unknown
147-1	OR	1 arrow pt blade	Late Prehistoric
147-2	OR	purple glass	Historic, 1880-1915
154-1	CL	purple glass	Historic, 1880-1915
154-2	CL	2 chert flakes, manuport, oxidized spall	unknown

Appendix 2-5
Isolated Find Data-Scattered Small Tracts

SST-IF-1	HU	1 Sinbad Side-notched pt	Late Prehistoric
2	HH	1 modified flake	unknown
3	HU	1 modified flake	unknown
4	EL	3 cairns/stone piles	unknown
5	EL	1 quartz flake	unknown
6	CD	1 chert flake	unknown

Appendix 2-5 (continued)

IF Number	Quad Map	Features/Artifacts	Suggested Affiliation/Age
SST-IF-7	CD	1 bifacial knife frag	unknown
8	CD	2 flakes-quartzite & chert	unknown
9	CD	1 modified flake	unknown
10	CD	1 chert flake	unknown
11	CD	1 chert flake	unknown
12	EE	3 chert flakes	unknown
13	EE	1 cobble cluster	unknown
14	EE	2 chert flakes	unknown
15	CD	3 chert flakes	unknown
16	FE	small purple medicine bottle	Historic, 1880-1915
17	EE	2 flakes, 1 biface frag	unknown
A	HU	2 chalcedony flakes, 1 shatter	unknown
B	HU	1 chalcedony flake	unknown
C	HU	1 chalcedony flake	unknown
D	HH	1 chalcedony flake	unknown
E	HH	1 chalcedony flake	unknown
F	HH	1 mudstone core	unknown
G	HH	1 chert flake	unknown
H	HH	1 chert flake, 1 modified flake	unknown
I	HH	1 chert biface	unknown
J	CD	trash dump, 5 x 5m	Historic, 1880-1930s
K	CD	glass scatter, 3 x 3m	Historic, 1880-1915
L	FE	1 chalcedony flake	unknown
M	FE	1 Snake Valley Gray sherd w/ appliqued rim	Fremont

Appendix 2-6
Isolated Find Data-Emery Tract

EMIF-2-1	EE	1 chalcedony flake, 1 Emery Gray sherd	Fremont
2-2	EE	2 modified flakes	unknown
5-1	EE	1 wagon axle & hub	Historic
29-1	EE	2 chalcedony flakes	unknown
29-2	EE	2 chert flakes, 1 proj pt frag	unknown
29-3	EE	9 flakes in wash	unknown
40-1	MB	4 flakes, 1 modified flake in wash	unknown
40-2	EE	2 chalcedony flakes	unknown
40-3	MB	5 flakes & tested cobble in wash	unknown
40-4	MB	2 chert flakes & tested cobble	unknown
43-1	MB	5 chalcedony flakes	unknown
43-2	MB	1 chalcedony biface	unknown
43-3	MB	1 modified flake	unknown
43-4	MB	1 Gypsum pt frag	Mid-Late Archaic
43-5	MB	1 distolateral scraper	unknown
45-1	MB	2 flakes, biface & adze in wash	unknown
45-2	MB	2 chalcedony flakes	unknown
45-3	MB	1 Pinto Shoulderless pt base	Early Archaic
67-1	WF	1 biface frag	unknown

Appendix 2-6 (continued)

IF Number	Quad Map	Features/Artifacts	Suggested Affiliation/Age
EMIF-67-2	WF	4 flakes, drill frag, pt midsection	Late Paleo-Indian?
67-3	WF	1 Desert Side-notched pt	Ute
111-1	MB	1 slab metate	unknown
111-2	MB	1 Emery Gray sherd	Fremont
111-3	MB	2 tested cobbles & flakes	unknown
111-4	MB	1 Emery Gray sherd	Fremont
111-5	MB	2 Sevier Gray sherds	Fremont
111-6	MB	1 modified flake	unknown
124-1	WF	2 Emery Gray sherds near buried, burned juniper log	Fremont
132-1	WF	1 Hawken Side-notched pt	Early Archaic
201-1	WF	1 chalcedony flake, 1 flake tool	unknown
201-2	WF	1 biface frag, mod flake, chert flake	unknown
201-3	WF	1 ovate scraper	unknown
201-4	WF	2 flakes, 1 modified flake	unknown
206-1	WF	2 chalcedony flakes	unknown
206-2	WF	3 flakes, core & scraper	unknown
251-1	WF	1 tested cobble & flakes	unknown
251-2	WF	1 Elko Corner-notched pt	Archaic?
251-3	WF	1 biface, 1 tobacco tin	prehistoric/Historic
251-4	WF	coal tailings	Historic
259-1	WF	1 boulder metate	unknown
259-2	WF	3 chert flakes	unknown
259-3	WF	1 chalcedony flake	unknown
259-4	WF	2 flakes & tested cobbles	unknown
273-1	MB	6 flakes & biface in washed context	unknown
274-1	WF	6 flakes & tested cobbles	unknown
274-2	WF	1 Gypsum pt frag	Mid-Late Archaic
274-3	WF	1 flake, 1 stemmed pt? base	Middle? Archaic
274-4	WF	1 chalcedony flake, 1 mano	unknown
290-1	WF	2 chert flakes, 2 modified flakes	unknown
290-2	WF	1 modified flake	unknown
290-3	WF	5 flakes	unknown
293-1	WF	1 chalcedony flake, 1 modified flake	unknown
300-1	MB	1 distolateral scraper	unknown
313-1	MB	2 Sevier Gray sherds	Fremont
313-2	MB	1 chopper	unknown
337-1	WF	2 Emery Gray sherds & core	Fremont
337-2	WF	2 chalcedony flakes	unknown
348-1	MB	15+ flakes: single core reduction	unknown
348-2	MB	2 chert flakes	unknown
385-1	WS	1 modified flake	unknown
385-2	WS	1 Gypsum pt	Mid-Late Archaic
385-3	WS	1 modified flake	unknown
385-4	WS	1 pickle jar (amethyst) & tin can	Historic, 1880-1890
385-5	WS	2 flakes, tested cobbles	unknown
385-6	WS	3 flakes-chalcedony & quartzite	unknown
385-7	WS	1 distolateral scraper, 1 mano	unknown
385-8	WS	1 Humboldt Concave-base A proj pt	Early Archaic

Appendix 2-6 (continued)

IF Number	Quad Map	Features/Artifacts	Suggested Affiliation/Age
EMIF-421-1	WS	7 Emery Gray sherds	Fremont
427-1	WS	1 proj pt frag, 3 flakes	Archaic?
427-2	WS	1 Lovell Constricted/Lake Mojave pt	Paleo-Indian
427-3	WS	1 biface frag	unknown
441-1	WS	1 chalcedony flake, 1 mod flake	unknown
441-2	WS	1 hammerstone	unknown
441-3	WS	1 modified flake	unknown
441-4	WS	2 chalcedony flakes	unknown
441-5	WS	4 flakes-chalcedony & quartzite	unknown
441-6	WS	1 chalcedony flake, 2 modified flakes	unknown

Key

Quad Map:

CD = Castle Dale
CF = Cow Flats
CL = Cleveland
EE = Emery East
EL = Elmo
EW = Emery West
FE = Ferron
HH = Hadden Holes
HU = Huntington
MB = Mesa Butte
OR = Olsen Reservoir
WF = Walker Flat
WS = Willow Springs

Tool Classes

Prehistoric:

BB = burned bone
BK = bifacial knives
BS = bifacial scrapers
BT = blade tools
CE = ceramics
CT = core tools
DR = drills
FS = flake scrapers
GR = gravers
HS = hammerstones
MF = other modified flakes
MH = manos/handstones
MM = metates/millingstones
OG = other ground stone
PP = projectile points
RS = resharpening flakes
SL = shell
SP = spokeshaves
UB = unmodified bifaces
UC = unmodified cores
UU = unifaces

Historic:

AM = ammunition
GL = glass
LE = leather
ME = metal
NW = wire nails
TC = tin cans
WI = wire
WD = wood

APPENDIX 2-7
Previously Recorded Sites in the Emery Tract

Perm Site # (42-)	USGS Quad Map *	Emery Tract Sample Unit #: Surveyed	Unsurveyed	Site Characteristics	Year Recorded
EM151	WF		249	historic rock/wood foundation	1962
EM152	WF	234		lithic scatter	1962
EM153	WF		219	petroglyphs/sherds/lithics	1962
EM155	MB		111	sherds/lithics/hist. petroglyphs	1962
EM156	WF		235	lithic scatter/proj pt	1962
EM158	MB		193	sherds/lithics	1962
EM159	MB		193	sherds/lithics	1962
EM160	MB		193	sherds/lithics	1962
EM161	MB		194	sherds/lithics	1962
EM162	MB		174	sherds/bone/chips & ground stone	1962
EM163	MB		174	petroglyphs	1962
EM181	WF		97	lithics/hearth	1972
EM182	WF		89	lithics/hearth	1972
EM183	WF		98	lithics/hearth	1972
EM184	WF		98	lithics/hearth	1972
EM185	WF		98	lithics w/ tools, hearth	1972
EM186	WF		98	lithics/hearth/historic bone	1972
EM187	WF		89	lithics w/ proj pts/2 hearths	1972
EM188	WF		89	sherds/lithics/2 hearths	1972
EM189	WF		89	sherds/lithics/2 hearths	1972
EM190	WF		89	lithics/4 hearths	1972
EM191	WF		89	lithics/2 hearths	1972
EM192	WF		80	sherds/chips & ground stone/hearth	1972
EM193	WF		89	lithics/hearth	1972
EM194	WF		80	sherds/lithics/hearth	1972
EM195	WF		80	sherds/lithics/2 hearths	1972
EM196	WF		80	lithics/hearth	1972
EM197	WF		80	sherds/lithics/hearth	1972
EM198	WF		80	lithics/hearth	1972
EM199	WF		80	lithics/3 hearths	1972
EM200	WF		80	lithics/2 hearths	1972
EM201	WF		80	lithics/hearth	1972
EM202	WF		98	lithics/hearth	1972
EM203	WF		98	chips & ground stone/2 hearths	1972
EM204	WF		98	lithics/hearth	1972
EM205	WF		98	lithic scatter	1972
EM206	WF		89	lithic scatter	1972
EM207	WF		98	lithics/historic ceramics/glass	1972
EM208	WF		89	fire-cracked rock/hearth	1972
EM209	WF		89	lithics/hearth	1972
EM210	WF		89	chips & ground stone/4 hearths	1972
EM211	WF		89	lithics/many tools/4 hearths	1972
EM212	WF		89	sherds/lithics/4 hearths	1972

APPENDIX 2-7 (continued)

Perm Site # (42-)	USGS Quad Map *	Emery Sample Surveyed	Tract Unit #: Unsurveyed	Site Characteristics	Year Recorded
EM213	WF		89	sherds/lithics/hearth	1972
EM214	WF		89	lithics/proj pt/hearth	1972
EM215	WF		89	lithics (all obsidian)/hearth	1972
EM216	WF		89	lithics/5 hearths	1972
EM217	WF		90	lithics/2 hearths	1972
EM218	WF		90	chips & ground stone/3 hearths	1972
EM219	WF		90	lithics/hearth	1972
EM220	WF		90	lithic scatter	1972
EM221	WF		90	lithic scatter	1972
EM222	WF		90	sherds/chips & ground stone/hearth	1972
EM223	WF		90	lithics/hearth	1972
EM606	WF		354	lithics/stained soil	1976
EM609	WF		80	chips & ground stone/ss rubble	1976
EM610	WF		90	lithic scatter	1976
EM657	WF		361	lithics/hearth	1976
EM660	WF		354	lithics/6+ hearths	1976
EM661	WF		354	chips & ground stone	1976
EM662	WF		320	chips & ground stone/proj pt	1976
EM667	WF		282	lithic scatter	1976
EM669	WF	251		sherds/lithics/2 rockshelters	1976
EM672	WF		361	sherds/lithics/2 rockshelters	1976
EM673	WF		361	lithics/hearth/rockshelter	1976
EM674	WF		250	lithic scatter	1976
EM675	WF		360	sherds/lithics/rockshelter	1976
EM714	WF		90	paleontological: shells	1976
EM770	WF	234		ground stone/historic trash	1977
EM1067	MB		73	lithic scatter	1978
EM1171	MB		49	lithic scatter	1979
EM1173	WF		89	lithic scatter/charcoal	1979
EM1178	MB		145	chert quarry/scatter	1979
EM1205	WF		190	chips/ground & burned stone/hearth	1980
EM1212	WS		388	sherds/lithics/cists/rockshelter	1980
EM1213	WF		81	lithic scatter	1980
EM1216	MB		164	lithics/rockshelter	1980
EM1237	WF		189	rockshelter/hearth/trash midden	1980
EM1238	WS		387	lithic scatter	1980
EM1239	WS		387	rockshelter/hearth/structures/trash	1980
EM1240	WF		280	lithics/hearth	1980
EM1241	WF		191	sherds/lithics/stained soil	1980
EM1254	WS		435	lithics/rockshelter	1980
EM1255	WS		435	lithic scatter	1980
EM1256	MB	336		lithic scatter	1980
EM1262	MB		237	lithic scatter	1980
EM1263	MB		347	lithic scatter/proj pt	1980
EM1448	WF		361	lithic scatter	1981
EM1464	EE		16	lithics/rockshelter	1981

APPENDIX 2-7 (continued)

Perm Site # (42-)	USGS Quad Map *	Emery Tract Sample Surveyed	Emery Tract Unit #: Unsurveyed	Site Characteristics	Year Recorded
EM1636	EE		6	lithic scatter	1983
SV5	WF	337		Snake Rock Village	1956
SV287	WF		136	3 hearths	1972
SV415	WF		126	chips/ground & burned stone/ structures	1973
SV416	WF		126	chips/burned stone/hearth/mounds	1973
SV417	WF		126	chips/ground stone/rock clusters	1973
SV421	WF		166	chips/ground & burned stone	1973
SV438	WF	137		chips/ground & burned stone/mounds	1973
SV439	WF	137		chips/burned stone/stained soil	1973
SV440	WF	137		lithic scatter	1973
SV474	WS	421		sherds/lithics	1973
SV475	WS		408	lithic scatter	1973
SV476	WS		408	lithics/5 bifaces	1973
SV477	WS		408	sherds/lithics/ash	1973
SV478	WS		408	lithic scatter	1973
SV479	WS		395	lithic scatter	1973
SV480	WS		408	sherds/lithics	1973
SV610	WF		365	lithic scatter	1974
SV670	WF		371	rockshelter/structure	1974
SV897	WF		177	formerly 42EM54; no info	1975
SV921	WF		135	lithic scatter	1976
SV922	WF		83	lithic scatter	1976
SV923	WF		75	sherds/lithics	1976
SV1074	WF		305 & 315	sherds/lithics/structure	1978
SV1343	WS		423	lithic scatter	1980
SV1391	WF		244	sherds/lithics/burned stone/ structure?	1980
SV1591	WF		176-177,186	sherds/lithics/burned stone	1982
SV1592	WF		176	sherds/chips/ground stone/structure	1982
SV1593	WF		176	sherds/chips/burned stone/hearth	1982
SV1594	WF		168	chips/burned stone/hearth	1982
SV1595	WF		168	lithic scatter	1982
SV1596	WF		167	lithics/hearth	1982
SV1597	WF		167	chips/ground & burned stone/hearth	1982
SV1598	WF		167 & 177	sherds/chips & ground stone/ hearth/structure	1982
SV1599	WF		167	chips/burned stone/hearth	1982
SV1600	WF		167	sherds/chips/ground stone/structure	1982
SV1601	WF		167	chipped & burned stone/hearth	1982
SV1608	WF		165	chipped, ground & burned stone/ hearth	1982

Key:

* WF = Walker Flat WS = Willow Springs
MB = Mesa Butte EE = Emery East

Appendix 3

Standard Form OF-272

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2.	3. Recipient's Accession No.

4. Title and Subtitle An Archaeological Sample Inventory of the Elmo, Emery and Scattered Small Tracts in Castle Valley, Central Utah.

5. Report Date May 1985

6.

7. Author(s) Kevin D. Black and Michael D. Metcalf

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Metcalf Archaeological Consultants, Inc.
1301 Brush Creek Rd.
P. O. Box 899
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10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
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13. Type of Report & Period Covered
Final 10/83-5/85

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words) Archaeological inventory totalling 8,880 acres in three study areas was completed in Castle Valley, central Utah. In Elmo Tract a 14,000 acre area in the northern valley, a 20% sample of eighty acre quadrats yielded eight sites (two historic, six prehistoric) and 36 isolated finds. In the Emery Tract a 37,000 acre block, a 10% sample survey of 80 acre units identified 109 sites--nine previously recorded and ten containing Historic period components--and 77 IFs. Between these tracts lie the Scattered Small Tracts; 25 land parcels 40 to 320 acres, where 26 sites (including two Historic components and one paleontological locus) and 30 IFs were recorded. Thus, a total of 143 sites and 143 IFs was identified within 106 land units. Cultural affiliations include Paleo-Indian, Archaic, Fremont, Ute and Euro-American groups; 65 of 143 sites are evaluated eligible/potentially eligible for the National Register of Historic Places. Using map-readable environmental variables, predictive models of site location were developed using discriminant analysis and logistic regression. Testing and refinements in preliminary versions of one model resulted in an 82% correct classification rate for sites. The contributions of the data base to local cultural history, and problems and prospects for future predictive modelling efforts are discussed.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

Archaeological Sample Inventory
Central Utah
Castle Valley
Elmo, Emery & Scattered Small Tracts
Predictive Modelling
Prehistoric, Historic & Paleontologic Sites
Paleo-Indian through Historic periods
Carbon, Emery & Sevier Counties

c. COSATI Field/Group

18. Availability Statement

19. Security Class (This Report)

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22. Price

(See ANSI-Z39.18) See Instructions on Reverse OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce

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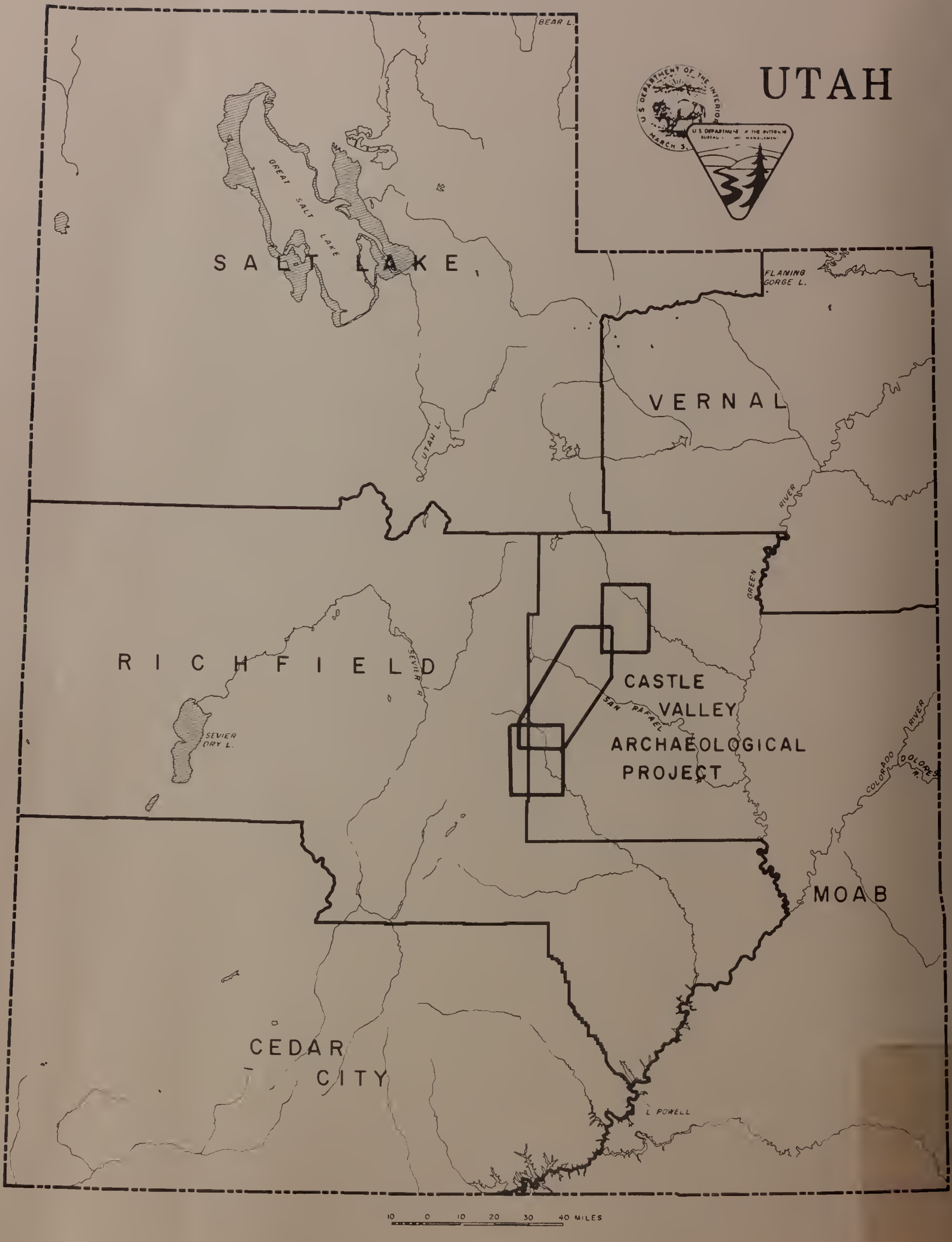
17 Gardiner F. Dalley and Douglas A. McFadden. *The Archaeology of the Red Cliffs Site.* (1985)

18 J.E. Bradley, W.R. Killam, G.R. Burns, M.A. Martorano. *An Archaeological Survey and Predictive Model of Selected Areas of Utah's Cisco Desert.* (1986)

19 K.D. Black and M.D. Metcalf. *The Castle Valley Archaeological Project: An Inventory and Predictive Model of Selected Tracts.* (1986)

20 B.A. Walling, R.A. Thompson, D.G. Weder. *Excavations at Quail Creek* With Ancillary Studies by K.M. Heath and L.W. Lindsay. (1986)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